Big Lake Aquatic Vegetation Management Plan Update

Noble County, Indiana

2007 - 2011

http://129.79.145.7/arcims/statewide%5Fmxd/viewer.htm

Prepared for:

The Big Lake Association

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Executive Summary

In 2007, 18 acres in the first basin of Big Lake were treated with Renovate, and 22 acres in basins 2 and 3 were treated with 2, 4-D for the control of Eurasian watermilfoil (EWM). These treatments were funded by the LARE Program and the Big Lake Association. Eurasian watermilfoil was collected at 23.3% of all rake sample locations during the May 17, 2007 Tier II aquatic vegetation survey. Herbicide treatments for the control of Eurasian watermilfoil were conducted on June 7, 2007. The post treatment survey conducted on August 10, 2007 found that Eurasian watermilfoil site frequency had declined from 23.3% in May, to just 1.7% in August. The 2007 treatment strategy resulted from vegetation survey results from 2006 and spring of 2007. In 2006, Aquatic Weed Control conducted a Tier II quantitative plant survey and a Tier I qualitative survey to characterize the plant community of Big Lake. An early season survey was conducted by the IDNR on May 30, 2006, and the late season survey was conducted by Aquatic Weed Control on August 30, 2006.

Aquatic Weed Control recommends Sonar herbicide for the control of Eurasian watermilfoil in Big Lake. Based on Aquatic Weed Control's past experience, Sonar should provide the most complete and long term control of Eurasian watermilfoil and is likely to be more cost effective than Renovate and 2, 4-D over a 4 year period. However, based on the LARE permit meeting on November 8, 2007, a Sonar treatment on Big Lake is not likely to be permitted by the IDNR.

The 2008 treatment strategy will be much the same as in 2007, although Basin #1 will be treated with 2, 4-D and basins 2 and 3 will be treated with Renovate. In 2007, Renovate was accidentally switched with 2, 4-D in Basin #1. It is important to note that Eurasian watermilfoil will be the only plant species specifically targeted in this project, as LARE funds will be awarded only for the control of invasive plant species. The goal is not to eliminate vegetation in Big Lake, but to improve the health of the plant community. Native vegetation will still be abundant in shallow areas after treatment, and control of these natives must be privately funded. The goal will be to reduce the Eurasian watermilfoil population and allow for the recovery of native plant species that will provide better fish habitat, foster good water quality and pose less interference to recreational use of the lake.

The 2, 4-D and Renovate treatments conducted in 2007 were very successful at reducing Eurasian watermilfoil abundance, but it is very important for all parties to understand that although 2, 4-D and Renovate treatments provide very effective EWM control, they only provide season long control. In 2008, Eurasian watermilfoil is expected to return to the 2007 treatment areas. Renovate and 2, 4-D cannot be expected to eradicate Eurasian watermilfoil in Lake George. Maintenance of the Eurasian watermilfoil must be conducted on a yearly basis with this treatment program. Cost estimates for 2008 are included below. These figures are estimates only and are subject to change pending future chemical pricing.

Project	2008	2009	2010	2011	4 Year Cost Totals
Treat 18 acres in Basin #1 with 2, 4-D	$6,480	$6,480	$6,480	$6,480	
Treat 22 acres in Basins 2 and 3 with Renovate	$10,450	$10,450	$10,450	$10,450	
Total Estimated Costs	$16,930	$16,930	$16,930	$16,930	**$ 67,720**
Total LARE share – subject to availability	$15,237	$15,237	$15,237	$15,237	**$ 60,948**
Total Association's Share	$1,693	$1,693	$1,693	$1,693	**$ 6,772**

Acknowledgements

Aquatic vegetation surveys conducted on Big Lake were made possible by funding from the Big Lake Association and the Indiana Department of Natural Resources through the Lake and River Enhancement program (LARE). Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for Tier II aquatic vegetation surveys. Gwen White and Angela Sturdevant, aquatic biologists for the LARE program provided valuable consultation regarding the requirements and objectives of this lake management plan. Brad Fink and Jason Doll also provided assistance and training for data analysis computer programs. Aquatic Weed Control would also like to thank the members of the Big Lake Association for their commitment to improving this lake and for valuable discussion and input brought forward at the informational meeting held on September 18, 2007.

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1.0 Introduction

The first LARE funded aquatic vegetation survey conducted on Big Lake by Aquatic Weed Control took place on August 30, 2006. Another vegetation survey was conducted earlier in 2006 by District 3 Fisheries personnel on May 30th. Based on the results of these 2006 surveys, Eurasian watermilfoil treatments were recommended for 2007.

In 2007 a Tier II vegetation survey was conducted on May 17, 2007 to confirm Eurasian watermilfoil abundance and gather more pre-treatment data about the plant community. The LARE funded Eurasian watermilfoil herbicide treatments were conducted on June 7, 2007. Eighteen acres in Basin #1 were treated with Renovate and 22 acres in Basins #2 and #3 were treated with 2, 4-D herbicide. A late season Tier II survey was conducted by Aquatic Weed Control on August 10, 2007 to evaluate the plant community. Table 1 summarizes LARE activities on Big Lake.

Table 1: Big Lake LARE History

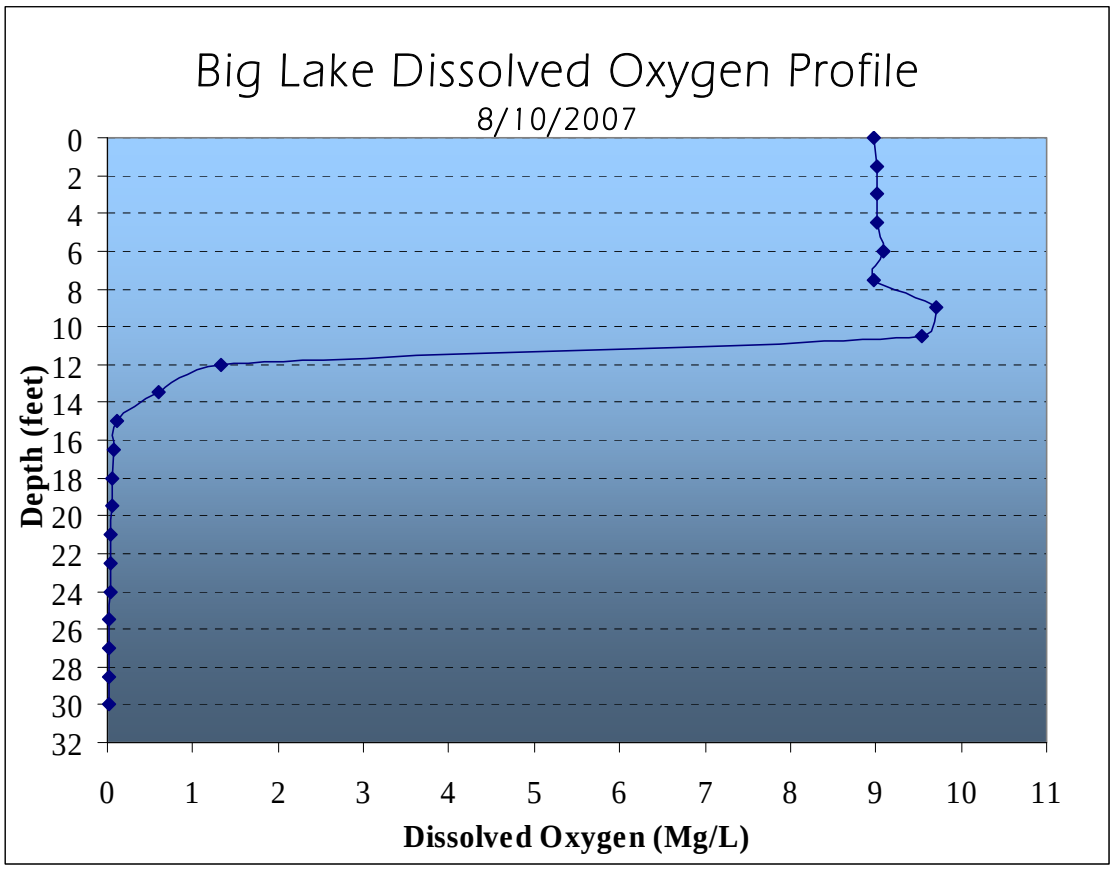
Year	Action	Date	Funding Source
2006	Spring Tier II Survey (IDNR)	May 30, 2006	Lake and River Enhancement Program (LARE)
	Late Season Tier II survey	August 30, 2006	Big Lake Association
	Lake Management Plan Development	Fall/Winter 2006	
2007	Spring Tier II Vegetation Survey	May 17, 2007	Lake and River Enhancement Program (LARE)
	LARE Funded 2, 4-D and Renovate Treatment for EWM (40 acres)	June 7, 2007	Big Lake Association
	Late Season Tier II Vegetation Survey	August 10, 2007	

2.0 Watershed and Lake Characteristics

Big Lake is located in southwest Noble County, 7 miles north of Columbia City on State Road 109. It has 228 surface acres with a maximum depth of 70 feet and an average depth of 24.7 feet (Pearson, 2000). Water volume is estimated at 1.83 billion gallons (IDNR Division of Soil Conservation 1995). Big Lake has five inlets, with the two largest being Sell Branch Inlet entering in the southeast and the Crane Lake Inlet entering the lake from the northeast.

Secchi depth was measured at 5.0 feet on May 17, 2007, and at 4.1 feet on August 10, 2007. Aquatic Weed Control measured dissolved oxygen and temperature throughout the water column in Big Lake on August 10, 2007. This data was used to construct dissolved oxygen and temperature profiles for Big Lake (Figure 1).

Figure 1: Big Lake Dissolved Oxygen Profile

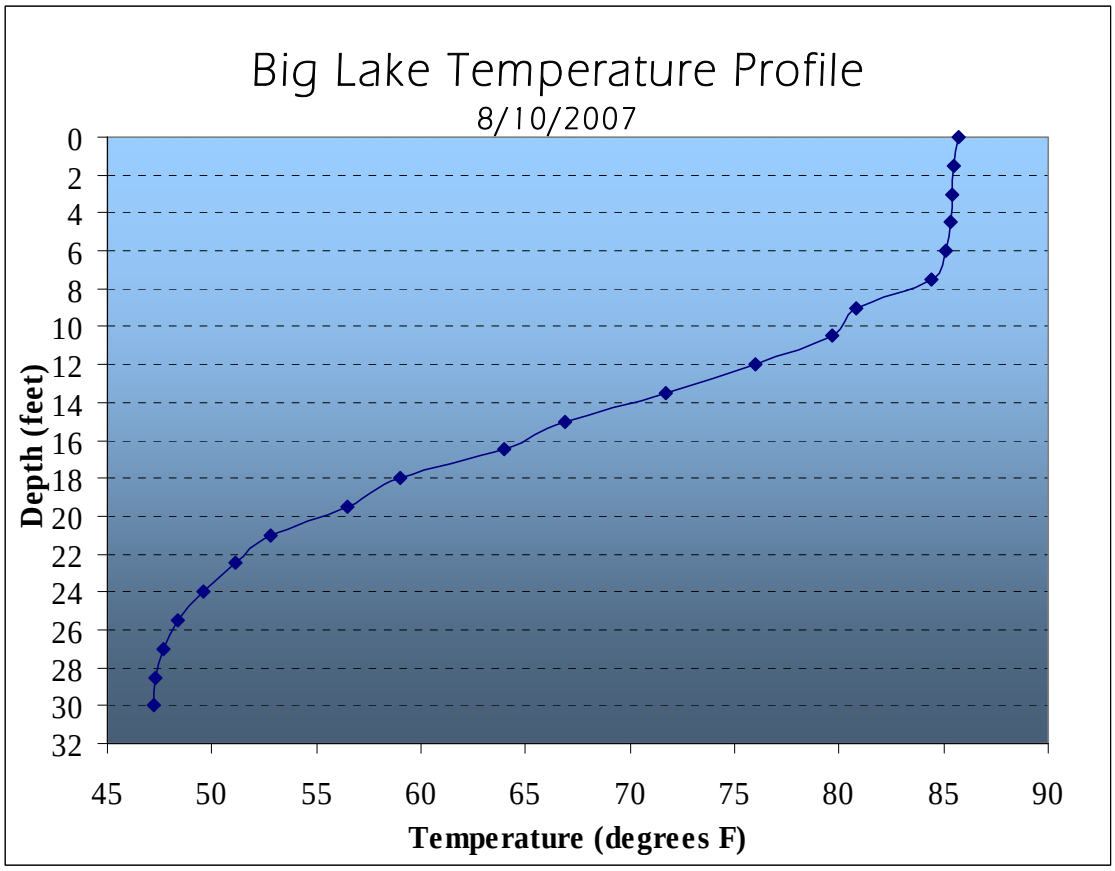


Dissolved oxygen requirements to maintain healthy fish populations of warm-water species are at least 2-5 mg of oxygen per liter of water, while cold-water fish species require 5-9 mg of oxygen per liter of water (Kalff, 2002, p237).

The metalimnion is the transition zone between the surface water and the deep water. It is usually accompanied by rapid changes in dissolved oxygen and temperature. Big Lake's metalimnion is between 10 and 14 feet as indicated by the rapid decline in dissolved oxygen.

Figure 2 shows a water temperature profile for Big Lake.

Figure 2: Big Lake Temperature Profile



The thermocline is a rapid temperature change associated with the transition from surface water to deep water. In Big Lake water temperature remains relatively stable from the surface down to 8 feet. After 8 feet temperature starts to drop more rapidly with depth. This indicates a thermocline starting at 8 feet.

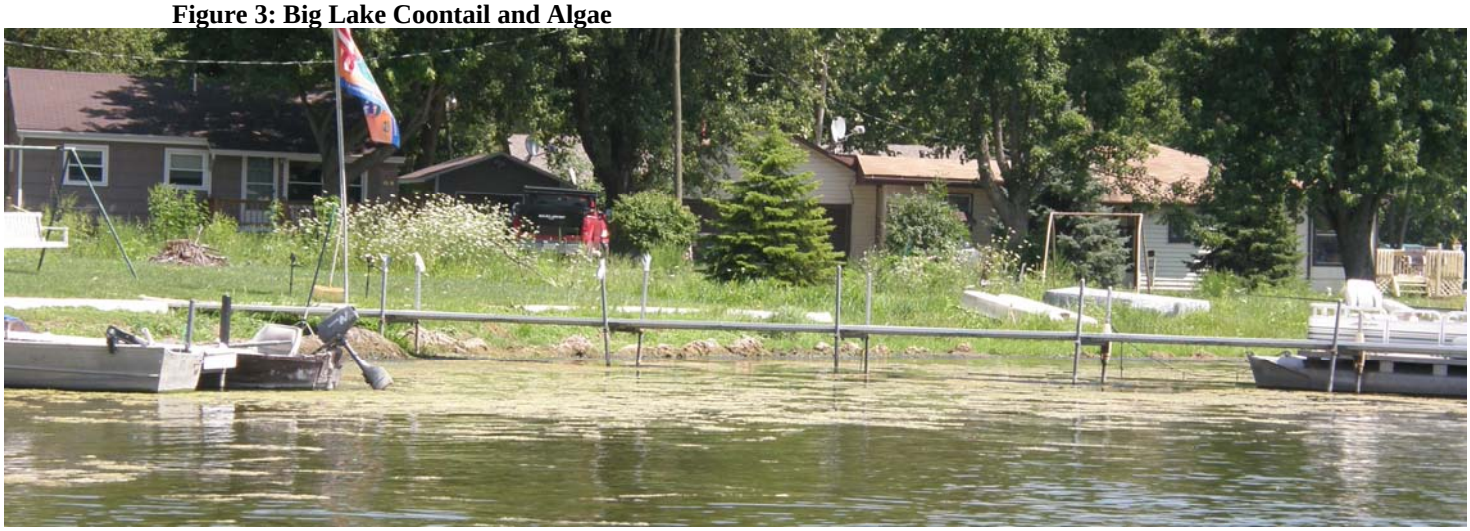
3.0 Lake Uses Update

Popular activities on Big Lake are much the same as in 2006. They include boating, skiing, fishing, and nature observation in the undeveloped portions of the second and third basins.

Big Lake is a popular lake for fishermen. Largemouth bass, bluegills and yellow perch are all very popular sport fish and all are common in Big Lake. More information about the Big Lake fishery is included in section 4.0 in this report. Summer weekends can be very crowded on the lake, with the public access site having limited parking space available. The lake also has a 10 mph speed limit, with high speed boating permitted in the first basin between 1 p.m. and 4 p.m. daily.

In 2007 Eurasian watermilfoil treatments greatly reduced site frequency, although matted coontail and algae still caused recreational problems. Figure 3 shows an area of matted coontail and Algae in the first basin of Big Lake.

Figure 3: Big Lake Coontail and Algae



4.0 Fisheries Update

District 3 Fisheries Biologist Jed Pearson was contacted for the latest fisheries data for Big Lake. No fisheries surveys took place on Big Lake during 2007. The most recent fisheries data can be found in the 2006 lake management plan.

5.0 Problem Statement

Eurasian watermilfoil continues to be the major invasive threat to the Big Lake plant community. Renovate and 2, 4D treatments in 2007 were successful at reducing Eurasian watermilfoil abundance, but it is important to note that although 2, 4-D treatments provide very effective EWM control, they only provide season long control. In 2008, Eurasian watermilfoil is expected to return to the 2007 treatment areas. 2, 4-D cannot be expected to eradicate Eurasian watermilfoil in Big Lake. Maintenance treatments for Eurasian watermilfoil must be conducted on a yearly basis with the current treatment program.

In lakes where Eurasian milfoil is left unchecked, well-diversified plant communities can be decimated, although in some lakes native plants compete well with Eurasian watermilfoil. Eurasian milfoil has the ability to "overwinter," giving it a distinct growth advantage over many native plants. The milfoil lies dormant during the winter months instead of dying back completely, as do many natives. As spring arrives, the dormant milfoil plants have a head start on many native plants and reach the surface faster, shading out the natives. Eurasian milfoil grows profusely, provides poor fish habitat, inhibits boat navigation, and causes annoyances and even recreational hazards to skiers, swimmers, and other members of the public wishing to enjoy the lake.

Big Lake's littoral zone (shallow water area) occupies a relatively small percentage of its total surface acreage (~17%). The large amount of deep water in the lake helps limit milfoil distribution, although it still causes significant recreational impairment in near shore areas around docks, piers and beaches. The near shore areas should be the focus of management

activities to improve recreation and reduce the Eurasian watermilfoil population. Selectively treating for Eurasian watermilfoil on a yearly basis should help native plants compete the invasive plant.

6.0 Vegetation Management goals and Objectives

The following management goals have been established by the IDNR for all lakes in Indiana, including those applying for LARE funding. Any management practices implemented on Big Lake are to directly facilitate the achievement of these three goals:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality and is resistant to minor habitat disturbances and invasive species.

2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.

3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

Specific Objectives:

Specific objectives are needed to ensure that the fundamental goals of the LARE program are met. The following steps are recommended to help achieve LARE management goals for Big Lake.

1. **Areas infested with Eurasian watermilfoil in basin #1 will be treated with 2, 4-D to reduce the Eurasian watermilfoil population in 2008.** Exact treatment areas will depend upon results of a spring 2008 visual survey.

2. **Areas infested with Eurasian watermilfoil in basins #2 and #3 will be treated with Renovate.** Again, exact treatment areas will depend upon results of a spring 2008 visual survey. Renovate treatments will protect native coontail in these areas.

3. **Vegetation surveys should be conducted to evaluate the plant community both before and after treatment in 2008.** A visual survey will be conducted in spring of 2008 to develop a treatment map for Eurasian watermilfoil. A Tier II vegetation survey should be conducted after the chemical treatment to evaluate the plant community.

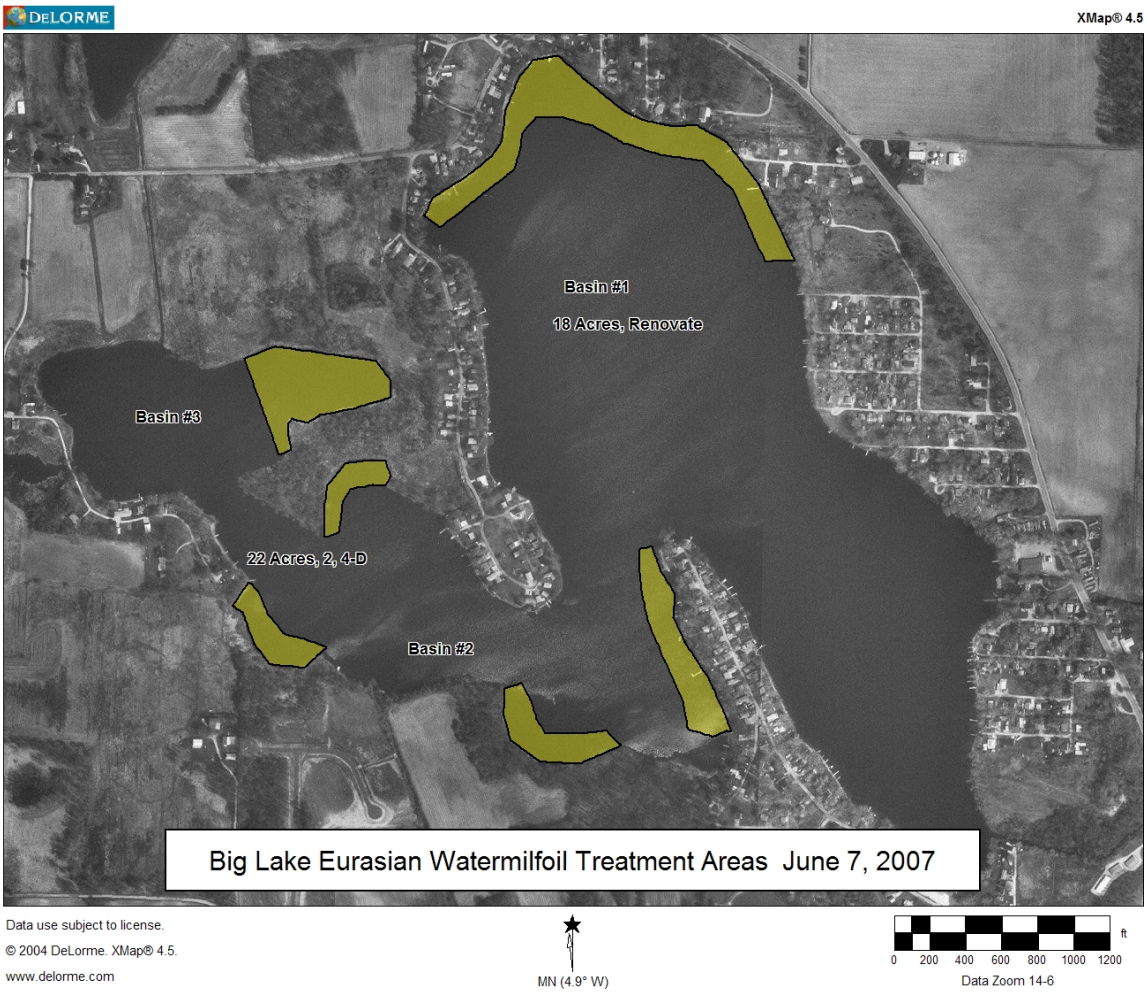
7.0 Past Management Efforts Update

District 3 Fisheries Biologist Jed Pearson was contacted to determine any major changes to vegetation control permits on Big Lake. The only significant changes in 2007 were the LARE funded herbicide treatments.

On June 7, 2007 the first LARE funded herbicide treatment was conducted on Big Lake. Eighteen acres in basin #1 of Big Lake were treated with Renovate for the control of

Eurasian watermilfoil. In basins #2 and #3, 22 acres were treated with 2, 4-D for the control of Eurasian watermilfoil. Figure 4 shows approximate locations of these treatment areas.

Figure 4: 2007 LARE Treatment Areas



8.0 Aquatic Plant Community Characterization Update

One major change in protocol for 2007 is the absence of the Tier I reconnaissance survey. Survey intensity is now being tailored to individual lakes, depending on their own unique set of circumstances and management activities. Some lakes which may have been surveyed twice annually in the past may only be surveyed once each season. Surveys on some lakes that have been intensely surveyed in recent years may change to visual surveys as opposed to more time consuming quantitative vegetation surveys. These changes provide better quality of service and more efficient use of funding on Indiana lakes.

An updated Tier II survey protocol has been established by the IDNR. These changes are outlined in the methods section (8.1).

8.1 Methods Update

The Tier II survey protocol was updated by the IDNR in 2007. New LARE Tier II protocol requires that sample sites be stratified by depth contour, and that data analysis be provided for each depth contour. Rake scores for plant species are recorded as 1, 3, or 5, as opposed to the original scoring system of 1, 2, 3, 4, or 5.

The number of sample sites needed for a Tier II survey still is based on both lake size and trophic state, as it was in 2006. Trophic state describes the productivity of a lake and is correlated with plant growth, secchi disk, and nutrient availability. There are 4 different trophic states listed by the IDNR: Oligotrophic, Mesotrophic, Eutrophic, and Hypereutrophic. Oligotrophic Lakes usually have clear water and few nutrients, while Hypereutrophic lakes usually have deeply stained water and are nutrient rich. Table 2 is taken from the IDNR 2006 Tier II protocol and shows the maximum depth that must be sampled for a lake in each trophic state. In oligotrophic lakes, where water is clear, plants may be able to grow in up to 25 feet of water because sunlight may still reach the lake bottom in deep water. In hypereutrophic lakes where water is turbid, lack of sunlight will prevent plants from growing in deep water, so the maximum sampling depth is only 10 feet.

Table 2: Sample Depth by Trophic State

Trophic State	Maximum Depth of Sampling (ft)
Hypereutrophic	10
Eutrophic	15
Mesotrophic	20
Oligotrophic	25

Table 3 is used to calculate the number of sample sites need in each depth contour by using lake size and trophic status. The new protocol attempts to more accurately describe the entire littoral zone of a lake and provide more detailed data analysis by separating the littoral zone into 5 foot depth segments.

Table 3: Sample Sites by Lake Size and Trophic State

Table 3. Sample size requirements as determined by lake size, trophic state, and apportioned by depth class.

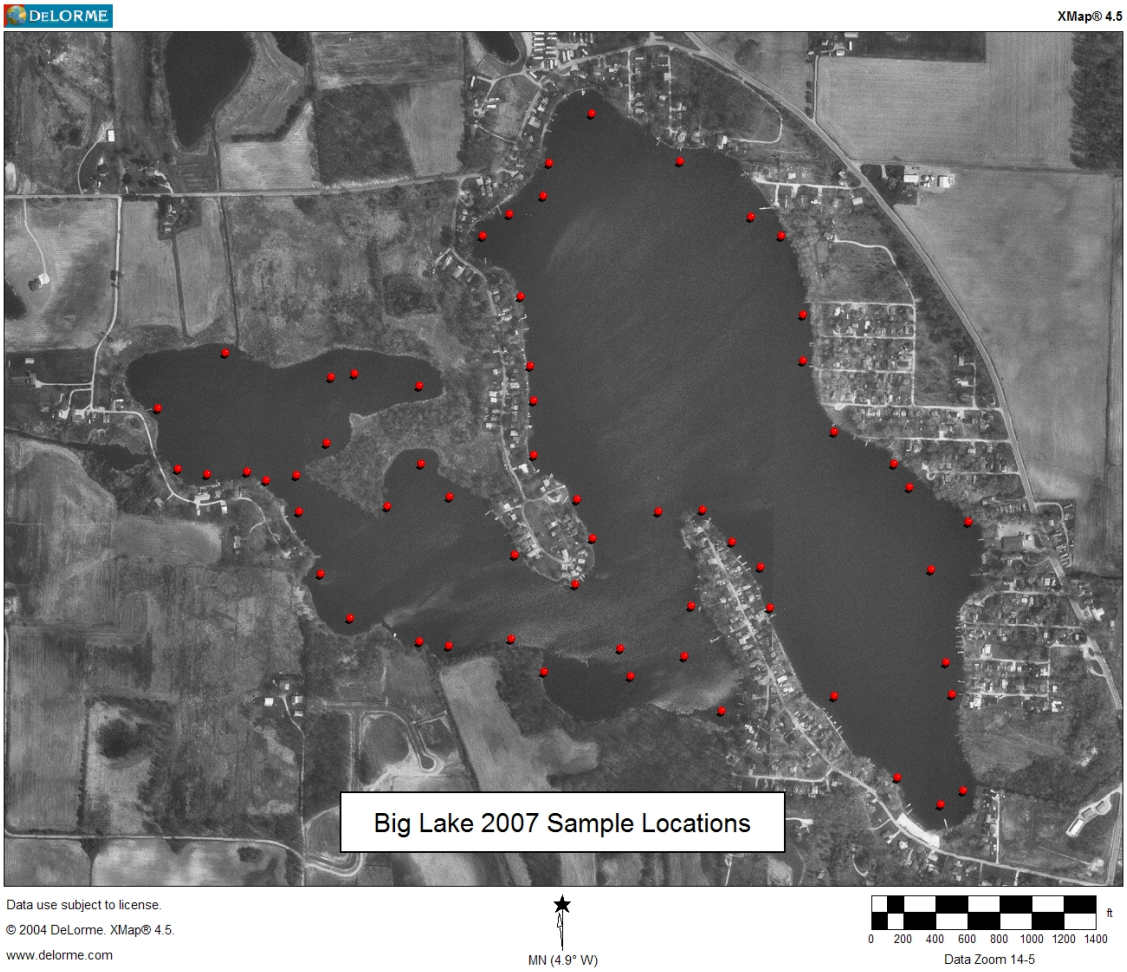
		Hypereutrophic		Eutrophic			Mesotrophic				Oligotrophic				
Lake Acres	Total # of Sites	0-5 foot contour	5-10 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	20-25 foot contour
<10	20	10	10	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	20	10	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	30	10	17	13	10	10	10	10	10	10	10	10	7	3
100-199	50	40	10	23	17	10	14	14	12	10	10	10	10	10	10
200-299	60	50	10	30	20	10	18	16	16	10	14	12	12	12	10
300-399	70	60	10	37	23	10	22	20	18	10	17	15	14	14	10
400-499	80	70	10	43	27	10	25	23	22	10	19	18	17	16	10
500-799	90	80	10	50	30	10	29	27	24	10	22	21	19	18	10
>=800	100	90	10	57	33	10	33	31	26	10	25	23	22	20	10

8.2 Results

8.2.1 Tier II Results

Two Tier II aquatic vegetation surveys were conducted by Aquatic Weed Control on Big Lake in 2007. The first was conducted on May 17, 2007 and the second was conducted on August 10, 2007. Secchi depth was measured at 5.0 feet on May 17th and at 4.1 feet on August 10th. Sixty rake samples were distributed throughout the lake. A total of 8 species of submersed aquatic plants were collected during the May survey, while 11 plant species were collected in the August survey. Two invasive species (Eurasian milfoil and curly-leaf pondweed) were found in each survey. The same sample locations are identical to 2006. Figure 5 shows these rake sample locations.

Figure 5: 2007 Rake Sample Locations



The following tables are data summaries for the 2007 aquatic vegetation surveys on Big Lake. These surveys help to describe the plant community, and will help identify any changes that take place in the years to come. Tables labeled “Overall” analyze every sample site, while the others describe the plants in each depth contour of the lake (0-5 feet, 5-10 feet, etc).

May 2007 Data Analysis

Table 4: May 2007 Data Analysis - Overall

Occurrence and Abundance of Submersed Aquatic Plants - Overall					
Lake:	Big Lake	Secchi:	5.0	SE Mean Species/site:	0.14
Date:	5/17/07	Littoral sites with plants:	35	Mean natives/site:	0.68
Littoral depth (ft):	9.0	Number of species:	8	SE Mean natives/site:	0.09
Littoral sites:	48	Maximum species/site:	4	Species diversity:	0.72
Total sites:	60	Mean number species/site:	1.07	Native diversity:	0.48

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	48.3	15.0	31.7	1.7	23.7
Eurasian Watermilfoil	23.3	16.7	6.7	0.0	7.3
Curly-leaf Pondweed	15.0	8.3	3.3	3.3	7.0
Elodea	8.3	6.7	1.7	0.0	2.3
Large-leaf Pondweed	3.3	1.7	1.7	0.0	1.3
Chara	3.3	3.3	0.0	0.0	0.7
Flat-stemmed Pondweed	3.3	3.3	0.0	0.0	0.7
Slender Naiad	1.7	1.7	0.0	0.0	0.3
Filamentous Algae	35.0				

Table 5: May 2007 Data Analysis 0 - 5 Feet

Occurrence and Abundance of Submersed Aquatic Plants 0-5 Feet					
Lake:	Big Lake	Secchi:	5.0	SE Mean Species/site:	0.18
Date:	5/17/07	Littoral sites with plants:	26	Mean natives/site:	1.00
Littoral depth (ft):	9.0	Number of species:	8	SE Mean natives/site:	0.13
Littoral sites:	30	Maximum species/site:	4	Species diversity:	0.74
Total sites:	30	Mean number species/site:	1.60	Native diversity:	0.53

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	66.7	16.7	46.7	3.3	34.7
Eurasian Watermilfoil	36.7	30.0	6.7	0.0	10.0
Curly-leaf Pondweed	23.3	10.0	6.7	6.7	12.7
Elodea	13.3	10.0	3.3	0.0	4.0
Chara	6.7	6.7	0.0	0.0	1.3
Flat-stemmed Pondweed	6.7	6.7	0.0	0.0	1.3
Large-leaf Pondweed	3.3	3.3	0.0	0.0	0.7
Slender Naiad	3.3	3.3	0.0	0.0	0.7
Filamentous Algae	63.3				

Table 6: May 2007 Data Analysis 5 - 10 Feet

Occurrence and Abundance of Submersed Aquatic Plants 5-10 Feet					
Lake:	Big Lake	Secchi:	5.0	SE Mean Species/site:	0.26
Date:	5/17/07	Littoral sites with plants:	9	Mean natives/site:	0.55
Littoral depth (ft):	9.0	Number of species:	5	SE Mean natives/site:	0.15
Littoral sites:	18	Maximum species/site:	4	Species diversity:	0.63
Total sites:	20	Mean number species/site:	0.80	Native diversity:	0.31

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	45.0	20.0	25.0	0.0	19.0
Eurasian Watermilfoil	15.0	5.0	10.0	0.0	7.0
Curly-leaf Pondweed	10.0	10.0	0.0	0.0	2.0
Large-leaf Pondweed	5.0	0.0	5.0	0.0	3.0
Elodea	5.0	5.0	0.0	0.0	1.0
Filamentous Algae	10.0				

August 2007 Data Analysis

Table 7: August 2007 Data Analysis - Overall

Occurrence and Abundance of Submersed Aquatic Plants - Overall					
Lake:	Big Lake	Secchi:	4.1	SE Mean Species/site:	0.22
Date:	8/10/07	Littoral sites with plants:	35	Mean natives/site:	1.37
Littoral depth (ft):	9.5	Number of species:	11	SE Mean natives/site:	0.20
Littoral sites:	50	Maximum species/site:	6	Species diversity:	0.81
Total sites:	60	Mean number species/site:	1.48	Native diversity:	0.78

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	46.7	13.3	23.3	10.0	26.7
Eel Grass	30.0	11.7	18.3	0.0	13.3
Slender Naiad	21.7	16.7	5.0	0.0	6.3
Leafy Pondweed	20.0	13.3	6.7	0.0	6.7
Curly-leaf Pondweed	10.0	8.3	1.7	0.0	2.7
Chara	8.3	1.7	6.7	0.0	4.3
Flat-stemmed Pondweed	3.3	3.3	0.0	0.0	0.7
Sago Pondweed	3.3	3.3	0.0	0.0	0.7
Eurasian Watermilfoil	1.7	1.7	0.0	0.0	0.3
Illinois Pondweed	1.7	1.7	0.0	0.0	0.3
Large-leaf Pondweed	1.7	1.7	0.0	0.0	0.3
Filamentous Algae	23.3				

Table 8: August 2007 Data Analysis 0 - 5 Feet

Occurrence and Abundance of Submersed Aquatic Plants 0-5 Feet					
Lake:	Big Lake	Secchi:	4.1	SE Mean Species/site:	0.32
Date:	8/10/07	Littoral sites with plants:	26	Mean natives/site:	2.33
Littoral depth (ft):	9.5	Number of species:	11	SE Mean natives/site:	0.28
Littoral sites:	30	Maximum species/site:	6	Species diversity:	0.83
Total sites:	30	Mean number species/site:	2.53	Native diversity:	0.80

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	70.0	20.0	36.0	13.3	39.3
Eel Grass	53.3	20.0	0.7	0.0	24.0
Slender Naiad	40.0	30.0	33.3	0.0	12.0
Leafy Pondweed	33.3	20.0	10.0	0.0	12.0
Chara	16.7	3.3	13.3	0.0	8.7
Curly-leaf Pondweed	16.7	13.3	13.3	0.0	4.7
Flat-stemmed Pondweed	6.7	6.7	3.3	0.0	1.3
Sago Pondweed	6.7	6.7	0.0	0.0	1.3
Eurasian Watermilfoil	3.3	3.3	0.0	0.0	0.7
Illinois Pondweed	3.3	3.3	0.0	0.0	0.7
Large-leaf Pondweed	3.3	3.3	0.0	0.0	0.7
Filamentous Algae	40.0				

Table 9: August 2007 Data Analysis 5 - 10 Feet

Occurrence and Abundance of Submersed Aquatic Plants - 5 to 10 ft.					
Lake:	Big Lake	Secchi:	4.1	SE Mean Species/site:	0.20
Date:	8/10/07	Littoral sites with plants:	9	Mean natives/site:	0.60
Littoral depth (ft):	9.5	Number of species:	5	SE Mean natives/site:	0.18
Littoral sites:	19	Maximum species/site:	3	Species diversity:	0.65
Total sites:	20	Mean number species/site:	0.65	Native diversity:	0.60

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	35.0	10.0	15.0	10.0	21.0
Eel Grass	10.0	5.0	5.0	0.0	4.0
Leafy Pondweed	10.0	10.0	0.0	0.0	2.0
Curly-leaf Pondweed	5.0	5.0	0.0	0.0	1.0
Slender Naiad	5.0	5.0	0.0	0.0	1.0

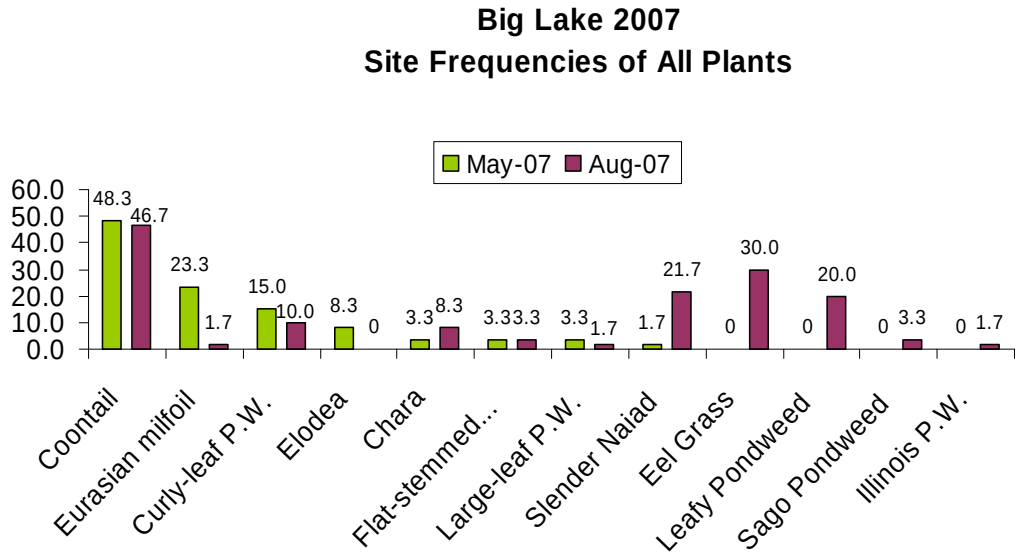
Site Frequency

Site frequency is a measure of how often a species was collected during the Tier II survey. It can be calculated by the following equation:

Site Frequency = (# of sites where the species was collected) X 100
Total # of littoral sample sites

Table 10 shows site frequencies for every plant collected in both the May and August Tier II Surveys. In the spring, coontail and Eurasian watermilfoil were the two most frequently collected plants. Coontail frequency remained very high in the August survey, but Eurasian watermilfoil frequency dropped from 23.3 % in May to just 1.7 % in August. Slender naiad, eel grass and leafy pondweed were all prevalent in August but not in May.

Table 10: Big Lake 2007 Site Frequencies



Species Diversity

The species diversity indices listed in data analysis tables help to describe the overall plant community. A species diversity index is actually measured as a value of uncertainty (H). If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that a chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependent upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

The species diversity index for Big Lake in the May survey was 0.72 while this diversity index increased slightly to 0.81 in the August survey. Many plants like eel grass and naiad are not prevalent until mid summer which likely helps account for higher diversity values late in the growing season. Native plant diversity in the May survey was measured at 0.48. This value is lower than the total species diversity, simply meaning that exotic species account for some of the diversity in Big Lake. Native diversity increased as well in the August survey,

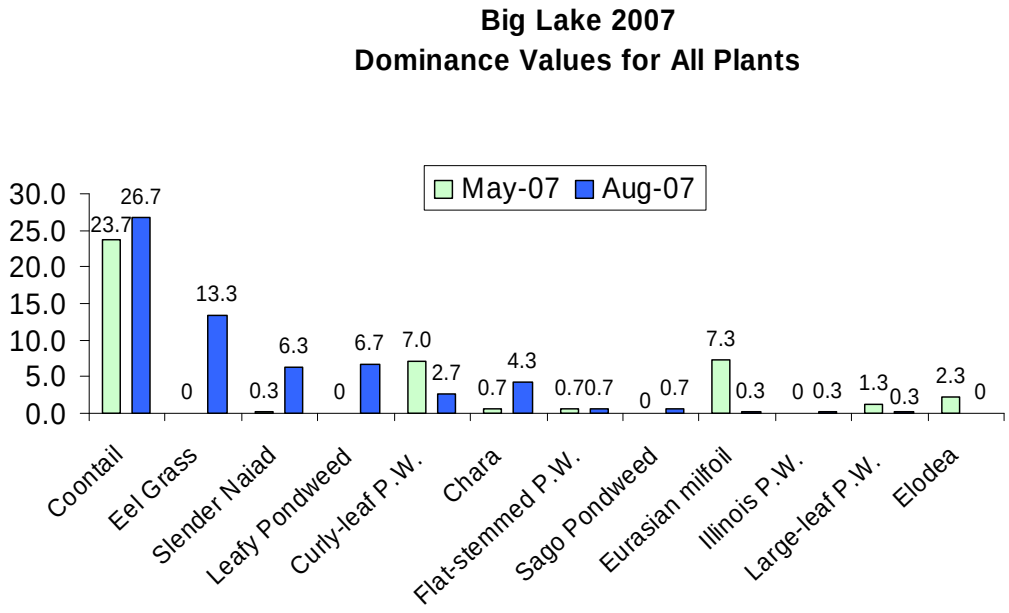
with a value of 0.78. Species diversity in Big Lake is slightly above average when compared with Pearson's average species metrics for area lakes.

Species Dominance

Species dominance is dependent upon how many times a species occurs, and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Table 11 shows dominance values for each plant collected in the 2007 Tier II surveys. Coontail was by far the most dominant plant in Big Lake in both May and August. Eurasian milfoil had a very high dominance score in relation to most native species in the spring, although its dominance decreased to 0.3 in the August. Eel grass was not collected in the May survey, but had become the second most dominant plant in August.

Table 11: Big Lake 2007 Dominance Values



Basin #1 vs. Basins #2 and #3

One of the major goals of the Big Lake treatment project is to compare Renovate and 2, 4-D treatments to determine what different effects each herbicide may have on both Eurasian watermilfoil and native plant populations. For this reason, data collected during the 2007 Tier II surveys was sorted according to treatment areas. Portions of Basin #1 were treated with Renovate while portions of Basins 2 and 3 were treated with 2, 4-D. For this reason, data from sample locations in Basin #1 was separated from sample locations in Basins 2 and 3.

It is important to note the limitations of this comparison. Only portions of each basin were treated, in accordance with Eurasian watermilfoil abundance (see figure 4). For this reason, there are many rake samples outside of the treatment areas which may also have an effect on

this data. Also natural life cycles of many plants in Big Lake (curly leaf, eel grass, slender naiad etc.) may make it more challenging to determine the effects that herbicide treatments are having on some species. Still it is valuable to compare the different basins of Big Lake to document any potential changes in the plant community. The following analysis tables separate data from each basin for both the May and August 2007 surveys.

May 2007

Table 12: May 2007 Data Analysis - Basin 1

Occurrence and Abundance of Submersed Aquatic Plants - Basin #1					
Lake:	Big - Basin #1	Secchi:	5.0	SE Mean Species/site:	0.21882199
Date:	5/17/07	Littoral sites with plants:	19	Mean natives/site:	0.75
Littoral depth (ft):	7.0	Number of species:	8	SE Mean natives/site:	0.15
Littoral sites:	25	Maximum species/site:	4	Species diversity:	0.77
Total sites:	32	Mean number species/site:	1.13	Native diversity:	0.61

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	43.8	15.6	28.1	0.0	20.0
Curly-Leaf Pondweed	21.9	12.5	3.1	6.3	10.6
Eurasian Watermilfoil	15.6	12.5	3.1	0.0	4.4
Elodea	12.5	9.4	3.1	0.0	3.8
Large-Leaf Pondweed	6.3	3.1	3.1	0.0	2.5
Flat-Stemmed Pondweed	6.3	6.3	0.0	0.0	1.3
Chara	3.1	3.1	0.0	0.0	0.6
Slender Naiad	3.1	3.1	0.0	0.0	0.6
Filamentous Algae	43.8				

Table 13: May 2007 Data Analysis - Basins 2 and 3

Occurrence and Abundance of Submersed Aquatic Plants Basins 2 and 3					
Lake:	Big - Basins 2-3	Secchi:	5.0	SE Mean Species/site:	0.17817416
Date:	5/17/07	Littoral sites with plants:	17	Mean natives/site:	0.61
Littoral depth (ft):	9.0	Number of species:	5	SE Mean natives/site:	0.11
Littoral sites:	23	Maximum species/site:	3	Species diversity:	0.60
Total sites:	28	Mean number species/site:	1.00	Native diversity:	0.21

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	53.6	14.3	35.7	3.6	27.9
Eurasian Watermilfoil	32.1	21.4	10.7	0.0	10.7
Curly-Leaf Pondweed	7.1	3.6	3.6	0.0	2.9
Chara	3.6	3.6	0.0	0.0	0.7
Elodea	3.6	3.6	0.0	0.0	0.7
Filamentous Algae	25.0				

August 2007

Table 14: August 2007 Data Analysis - Basin 1

Occurrence and Abundance of Submersed Aquatic Plants - Basin #1					
Lake:	Big - Basin #1	Secchi:	4.1	SE Mean Species/site:	0.25
Date:	8/10/07	Littoral sites with plants:	17	Mean natives/site:	1.16
Littoral depth (ft):	9.5	Number of species:	6	SE Mean natives/site:	0.25
Littoral sites:	26	Maximum species/site:	4	Species diversity:	0.76
Total sites:	32	Mean number species/site:	1.16	Native diversity:	0.76

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	37.5	9.4	28.1	0.0	18.8
Eel Grass	31.3	9.4	21.9	0.0	15.0
Slender Naiad	25.0	18.8	6.3	0.0	7.5
Leafy Pondweed	12.5	9.4	3.1	0.0	3.8
Chara	6.3	0.0	6.3	0.0	3.8
Sago Pondweed	3.1	3.1	0.0	0.0	0.6
Filamentous Algae	28.1				

Table 15: August 2007 Data Analysis - Basins 2 and 3

Occurrence and Abundance of Submersed Aquatic Plants - Basins 2-3					
Lake:	Big - Basins 2-3	Secchi:	4.1	SE Mean Species/site:	0.37
Date:	8/10/07	Littoral sites with plants:	18	Mean natives/site:	1.61
Littoral depth (ft):	9.5	Number of species:	11	SE Mean natives/site:	0.32
Littoral sites:	19	Maximum species/site:	6	Species diversity:	0.83
Total sites:	28	Mean number species/site:	1.86	Native diversity:	0.79

			Score Frequency		
Common Name	**Site Frequency**	**1**	**3**	**5**	**Dominance**
Coontail	57.1	17.9	17.9	21.4	35.7
Eel Grass	28.6	14.3	14.3	0.0	11.4
Leafy Pondweed	28.6	17.9	10.7	0.0	10.0
Curly-Leaf Pondweed	21.4	17.9	3.6	0.0	5.7
Slender Naiad	17.9	14.3	3.6	0.0	5.0
Chara	10.7	3.6	7.1	0.0	5.0
Flat-Stemmed Pondweed	7.1	7.1	0.0	0.0	1.4
Eurasian Watermilfoil	3.6	3.6	0.0	0.0	0.7
Illinois Pondweed	3.6	3.6	0.0	0.0	0.7
Larg-Leaf Pondweed	3.6	3.6	0.0	0.0	0.7
Sago Pondweed	3.6	3.6	0.0	0.0	0.7
Filamentous Algae	17.9				

Figure 6 shows site frequencies for plants collected in Basin #1 in both May and August of 2007. Eighteen acres of Basin #1 were treated with Renovate on June 7, 2007 (between the two surveys). Coontail, the most prevalent native plant in Big Lake showed a slight decline in site frequency from 43.8% in May to 37.5% in August. Curly leaf pondweed, Elodea, Eurasian watermilfoil, Large-leaf pondweed and flat-stemmed pondweed were all collected in May but not in August. Eel grass, Leafy pondweed, and sago pondweed were all collected in August but not in May.

Figure 6: 2007 Basin 1 Site Frequencies

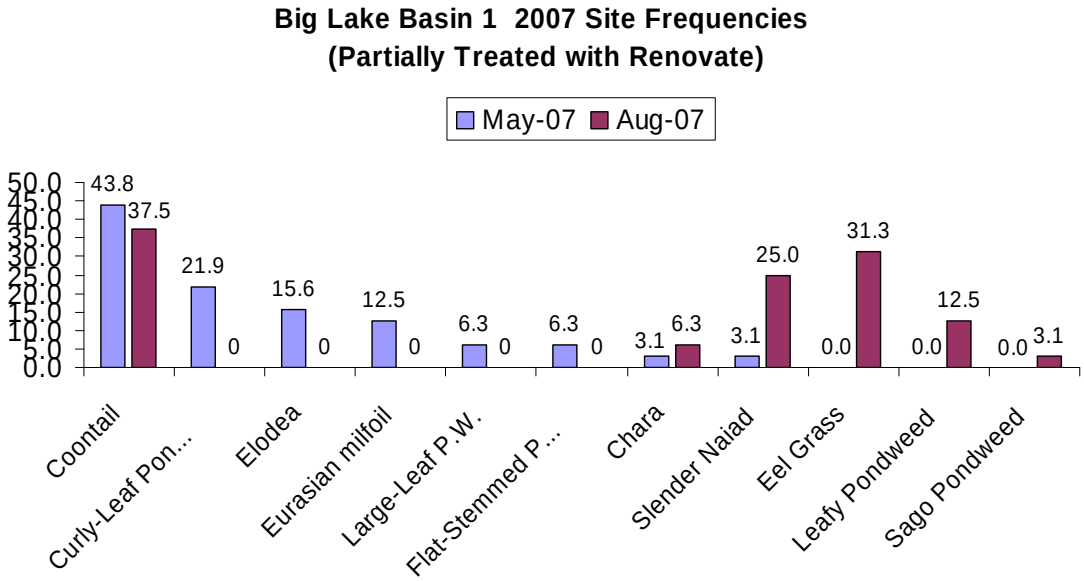
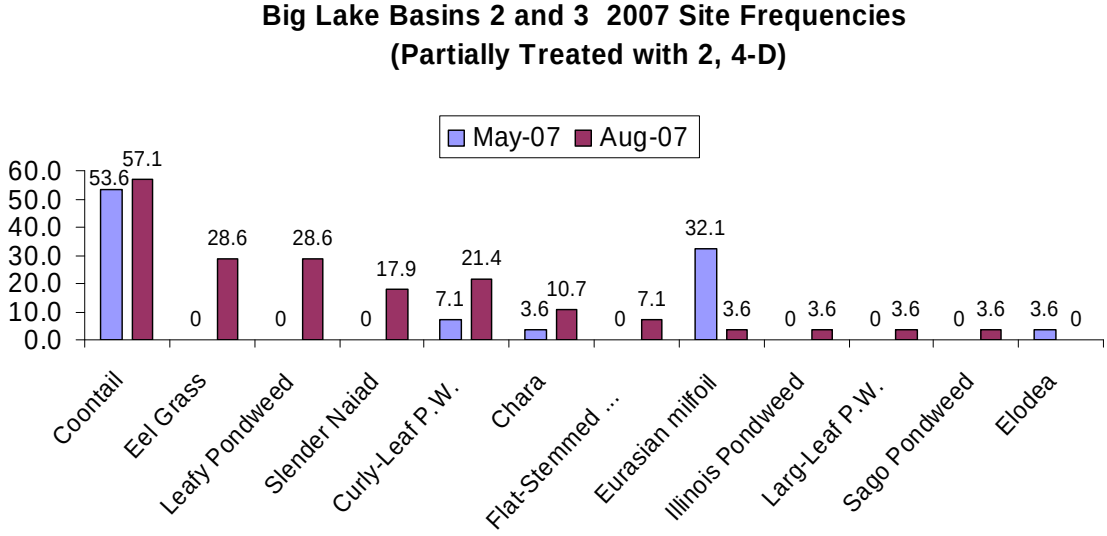


Figure 7 shows site frequencies for all plants collected in Basins 2 and 3 during 2007. Coontail site frequency in Basins 2 and 3 increased slightly from 53.6% in May to 57.1% in August. Eurasian watermilfoil site frequency declined from 32.1 % in May to 3.6% in August. Seven different species were not found in May but were found in August after the herbicide treatment. This is not unusual, as the late season surveys generally collect more species than do spring surveys.

Figure 7: Basins 2 and 3 Site Frequencies



8.3 Macrophyte Inventory Discussion

Twelve different species of submersed aquatic plants were collected in Big Lake during 2007. Eurasian watermilfoil and curly leaf pondweed were the two invasive species collected in Big Lake. Eurasian watermilfoil had an overall site frequency of 23.3% in the first vegetation survey on May 17, 2007. Its site frequency had declined to 1.7% in the August survey. It would appear that Eurasian watermilfoil was effectively reduced by the herbicide treatments in 2007. Curly leaf pondweed had an overall site frequency of 15.0 in May, and a site frequency of 10.0% in August.

Coontail was the most dominant plant in both surveys. Its site frequency declined slightly from 48.3% in May to 46.7% in August. Eel grass was not collected in May, but was the second most frequently collected plant in August. This is not unusual, as eel grass generally does not become abundant until July.

Plant diversity in Big Lake was above average when compared to Pearson's average species diversity (0.66) in a study of area lakes. Species diversity in May 2007 was 0.72, and increased to 0.81 in August.

Renovate vs. 2, 4-D Treatments on Big Lake

Although it is much too early to reach conclusions about the long term effects of Renovate and 2, 4-D on native plant populations, it is beneficial to note observations from the first year of treatments on Big Lake.

Renovate herbicide was used in Basin #1 and 2, 4-D was used in Basins 2 and 3.

Site frequency of Eurasian watermilfoil in Basin #1 declined from 12.5% before treatment in May 2007 to 0 in August after treatment. Site frequency of Eurasian watermilfoil in Basins 2 and 3 declined from 32.1% in May 2007 before treatment to 3.6% in August. It would appear that both herbicides are effectively controlling Eurasian watermilfoil in Big Lake. However, one interesting note is that surveys by both Aquatic Weed Control and the IDNR in 2006 appear to indicate that Eurasian watermilfoil in Big Lake shows some natural die off as the summer progresses.

Site frequency of coontail in Basin #1 declined from 43.8% before treatment to 37.5% after treatment. IDNR surveys also showed a reduction in coontail in Basin 1 (66% to 44%). If anything, this would seem unexpected, especially when compared to coontail data from Basins 2 and 3. Renovate is generally believed to have less of an effect on coontail than does 2, 4-D. At this point, to say that Renovate caused a decline in the coontail population would seem very premature, although it will be interesting to track coontail abundance in future years.

The 2, 4-D treatment in Basins 2 and 3 appeared to have no negative effect on coontail site frequency when compared with May 2007 data, although it is too early to know for sure. Coontail site frequency in Basins 2 and 3 actually increased from 53.6% in May to 57.1% in August. IDNR Vegetation surveys showed a slight decline in coontail in Basins 2 and 3 from 68% in May 2007 to 61% in August. Based on the variability in data, it would seem

premature to reach any conclusions about the effects of 2, 4-D on the coontail population in Basins 2 and 3.

Rake samples taken in Basins 2 and 3 found healthy, green stands of coontail, even though Eurasian watermilfoil site frequency was reduced from 32.1% before treatment to just 3.6 % after treatment. Figure 8 is a picture of healthy green coontail collected in the treatment area of Basin 3 in August (after treatment).

Figure 8: Basin 3 Coontail - August 2007

Aquatic Weed Control's data from 2006 showed that coontail had an overall site frequency of 60% in August of 2006. In August of 2007 overall site frequency of coontail was 46.7. From this it might be possible to conclude that the 2007 herbicide treatments stopped coontail from proliferating. However, in 2006 coontail site frequency actually declined from 76.7% in May to 60.0% in August without LARE funded treatments taking place. This was a much greater decrease in coontail abundance than was seen in Basin 1 during 2007. So there was less coontail present in August of 2007, than there was is August of 2006, but there was also less coontail to begin with in May of 2007 when compared to May of 2006. Looking at the variability between data from 2006 and 2007 it may be premature to make any conclusions about the effects of Renovate and 2, 4-D on coontail in Big Lake.

Tables 16 and 17 shows site frequencies of coontail and Eurasian watermilfoil in the different basins during 2006 and 2007 from surveys conducted by both Aquatic Weed Control and the IDNR. The variability in data seems to suggest more time is needed to reach conclusions about herbicide effects on coontail. Special thanks to District 3 Fisheries Biologist Jed Pearson for providing data from IDNR surveys.

Table 16: AWC Eurasian Watermilfoil and Coontail Data

AWC	**May 2006**	**August 2006**	**May 2007**	**August 2007**
Coontail				
Basin 1	No survey	65.6	43.8	37.5
Basins 2 and 3		53.6	53.6	57.1
Eurasian Watermilfoil	No Survey			
Basin 1		9.4	12.5	0
Basins 2 and 3		14.3	32.1	3.6

Table 17: IDNR Eurasian Watermilfoil and Coontail Data

IDNR	**May 2006**	**August 2006**	**May 2007**	**August 2007**
Coontail				
Basin 1	78	63	66	44
Basins 2 and 3	75	75	68	61
Eurasian Watermilfoil				
Basin 1	66	9	56	0
Basins 2 and 3	64	14	36	0

9.0 Aquatic Plant Management Alternatives

Management practices for the control of Eurasian watermilfoil have not changed significantly since the 2006 lake management plan.

10.0 Public Involvement

Table 18 summarizes the public questionnaire data received from input at the public meeting. Questionnaires were handed out to all in attendance at the public meeting, held on September 18, 2006. Eighteen people were in attendance. The Big Lake Association is very active, and privately funded herbicide treatments have been conducted on Big Lake in the past, especially in the first basin. Residents were pleased with Eurasian watermilfoil control but concerned about matted coontail and algae around shoreline areas.

Table 18: Public Questionnaire

Lake Use Survey (18 total) Lake name Big Lake

Are you a lake property owner? Yes 17 No 1

Are you currently a member of your lake association? Yes 17 No 0

How many years have you been at the lake?
2 or less - 0
2 – 5 years - 3
5-10 years - 5
Over 10 years - 10

How do you use the lake (mark all that apply)

17 Swimming	4 Irrigation
18 Boating	0 Drinking water
17 Fishing	2 Other Skiing

Do you have aquatic plants at your shoreline in nuisance quantities? Yes 14 No 4

Do you currently participate in a weed control project on the lake? Yes 15 No 3

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes 16 No 2

Does the level of vegetation in the lake affect your property values? Yes 12 No 6

Are you in favor of continuing efforts to control vegetation on the lake? Yes 17 No 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes 18 No 0

Mark any of these you think are problems on your lake:

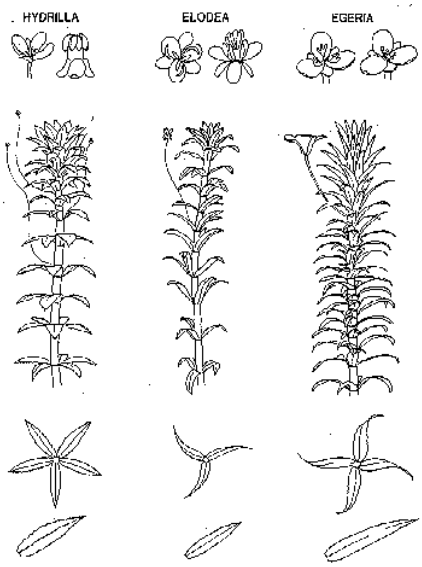
2 Too many boats access the lake
3 Use of jet skis on the lake
0 Too much fishing
3 Fish population problem
7 Dredging needed
1 Overuse by nonresidents
12 Too many aquatic plants
0 Not enough aquatic plants
10 Poor water quality
1 Pier/funneling problem

Please add any comments:
Do we have too many turtles?; Are there negatives to throwing fish remains back in the lake after cleaning; I don't live right on water; need to address run off from surrounding farms.

11.0 Public Education

Hydrilla

Hydrilla (*Hydrilla verticillata*) is an invasive aquatic plant species common throughout the southern United States. It federally listed as a noxious weed and causes severe ecological and recreational problems wherever it grows. It is considered to be much more destructive than other invasives like Eurasian watermilfoil and curly leaf pondweed because of its reproductive adaptations. It grows by fragmentation, as does Eurasian watermilfoil, but it also produces turions which can remain dormant in the sediment for 4 years or more (Van and Steward, 1990). It produces tubers at its root tips which can also reproduce after multiple years of dormancy. It can grow 1 inch each day and it quickly out-competes native plants. It forms dense beds that eliminate native plants, stunt fish populations, impede recreation and cause a drastic decrease in biodiversity (Colle and Shireman, 1980). Millions of dollars are spent each year for hydrilla maintenance each year in Florida alone. Eradication is unlikely once a population has been well established, although eradication has been achieved in newly infested waters using a herbicide called Sonar. Sonar is applied at a rate of 6 parts per billion and this concentration is maintained in the water for 180 days. Early detection can be crucial to an effective eradication program, and all lake residents and users are encouraged to be on the look-out for this invader. In fall of 2006, this plant was found in Lake Manitou, in Rochester, Indiana. This is the first instance of hydrilla in the upper Midwest. Prior to its appearance in Lake Manitou, The closest infestations of hydrilla were in Tennessee and Pennsylvania.



Hydrilla can easily be confused with native elodea. The major difference is that elodea has sets of leaves on the stem in whorls of three, while hydrilla usually has whorls of 5 leaves, although 4 to 9 leaves per whorl are possible with hydrilla. Hydrilla will also have small serrations on the leaf edges. More information on hydrilla can be found at the University of Florida's Center for Aquatic Invasive Plants (http://plants.ifas.ufl.edu/). More general information on aquatic invaders can be found at www.protectyourwaters.net.

12.0 Integrated Treatment Action Strategy

Aquatic Weed Control recommends Sonar herbicide for the control of Eurasian watermilfoil in Big Lake. Based on Aquatic Weed Control's past experience, it should provide the most complete and long term control of Eurasian watermilfoil and is likely to be slightly more cost effective than Renovate and 2, 4-D over a 4 year period. However, based on the LARE permit meeting on November 8, 2007, a Sonar treatment on Big Lake is not likely to be permitted by the IDNR.

The 2008 treatment strategy will be much the same as in 2007, although Basin 1 will be treated with 2, 4-D and Basins 2 and 3 will be treated with Renovate. In 2007, Renovate was accidentally switched with 2, 4-D in Basin #1. In 2008, up to 18 acres in Basin #1 will be treated with 2, 4-D for the control of Eurasian watermilfoil. Up to 22 acres in Basins 2 and 3 will be treated with Renovate for the control of Eurasian watermilfoil.

It is important to note that Eurasian watermilfoil will be the only plant species specifically targeted in this project, as LARE funds will be awarded only for the control of invasive plant species. The goal is not to eliminate vegetation in Big Lake, but to improve the health of the plant community. Native vegetation will still be abundant in shallow areas after treatment, and control of these natives must be privately funded. The goal will be to reduce the Eurasian watermilfoil population and allow for the recovery of native plant species that will provide better fish habitat, foster good water quality and pose less interference to recreational use of the lake.

The 2, 4-D and Renovate treatments conducted in 2007 were very successful at reducing Eurasian watermilfoil abundance, but it is very important for all parties to understand that although 2, 4-D and Renovate treatments provide very effective EWM control, they only provide season long control. In 2008, Eurasian watermilfoil is expected to return to the 2007 treatment areas. Renovate and 2, 4-D cannot be expected to eradicate Eurasian watermilfoil in Lake George. Maintenance of the Eurasian watermilfoil must be conducted on a yearly basis with this treatment program.

Herbicide Treatment Specifications

If 2, 4-D is used for herbicide treatments, then a concentration of 1.76 parts per million should be used to ensure adequate control. If Renovate is used, then the concentration should be between 1.0 and 1.5 parts per million.

13.0 Project Budget

Cost estimates for 2008 through 2011 are included below. These figures are estimates only and are subject to change pending future chemical pricing.

Project	2008	2009	2010	2011	4 Year Cost Totals
Treat 18 acres in Basin #1 with 2, 4-D	$6,480	$6,480	$6,480	$6,480	
Treat 22 acres in Basins 2 and 3 with Renovate	$10,450	$10,450	$10,450	$10,450	
Total Estimated Costs	$16,930	$16,930	$16,930	$16,930	**$ 67,720**
Total LARE share – subject to availability	$15,237	$15,237	$15,237	$15,237	**$ 60,948**
Total Association's Share	$1,693	$1,693	$1,693	$1,693	**$ 6,772**

Two vegetation surveys will also be conducted in 2008. The lake management plan must be updated to receive further funding for herbicide treatments. Costs for surveying and planning are estimated at $6,000. The LARE program would provide 90% of planning costs ($5,400) while the cost to the association would be $600.

2008 Survey and Lake Management Plan Update Costs $ 6,000

14.0 Monitoring and Plan Update Procedures

Since 2, 4-D will be used in Basin #1 in 2008, two Tier II vegetation surveys will be conducted on Big Lake in 2008. One survey will take place in spring prior to herbicide treatments. Data from this survey will be used to develop a treatment map for Eurasian watermilfoil in Big Lake. This map will then be submitted to the IDNR for approval. Should the treatment map be approved, herbicide treatments using 2, 4-D and Renovate will follow.

The second survey will take place after the treatments. The post treatment survey should be conducted in late summer to allow the slow acting herbicides to achieve full control before the survey is conducted.

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16.0 Appendices

16.1 Calculations

Fluridone Calculations:
The following paragraph is taken directly from the Sonar A.S. label. It outlines the specific procedures for calculating the amount of Fluridone needed to treat a body of water.

Application Rate Calculation - Ponds, Lakes and Reservoirs

The amount of Sonar A.S. to be applied to provide the desired ppb concentration of active ingredient in treated water may be calculated as follows:
Quarts of Sonar A.S. required per treated surface acre = Average water depth of treatment site (feet)
x Desired ppb concentration of active ingredient
x 0.0027
For example, the quarts per acre of Sonar A.S. required to provide a concentration of 25 ppb of active ingredient in water with an average depth of 5 feet is calculated as follows:
5 **x** 25 **x** 0.0027 = 0.33 quarts per treated surface acre
When measuring quantities of Sonar A.S., quarts may be converted to fluid ounces by multiplying quarts to be measured **x** 32. For example, 0.33 quarts **x** 32 = 10.5 fluid ounces.
Note: Calculated rates should not exceed the maximum allowable rate in quarts per treated surface acre for the water depth listed in the application rate table for the site to be treated.

The following chart outlines rate calculations for DMA – 4 IVM Herbicide. It was taken directly from the DMA – 4 IVM specimen label on Dow AgroSciences website. http://www.dowagro.com/ivm/invasive/prod/dma.htm

Submerged Aquatic Weeds: Including Eurasian Water Milfoil *(Myriophyllum spicatum)*

Treatment Site	Maximum Application Rate †	Specific Use Directions
Aquatic Weed Control in Ponds, Lakes, Reservoirs, Marshes, Bayous, Drainage Ditches, Canals, Rivers and Streams that are Quiescent or Slow Moving, Including Programs of the Tennessee Valley Authority	2.84 gallons (10.8 lb of acid equivalent) per acre foot	**Application Timing:** For best results, apply in spring or early summer when aquatic weeds appear. Check for weed growth in areas heavily infested the previous year. A second application may be needed when weeds show signs of recovery, but no later than mid-August in most areas. **Subsurface Application:** Apply DMA 4 IVM undiluted directly to the water through a boat mounted distribution system. Shoreline areas should be treated by subsurface injection application by boat to avoid aerial drift. **Surface Application:** Use power operated boat mounted boom sprayer. If rate is less than 5 gallons per acre, dilute to a minimum spray volume of 5 gallons per surface acre. **Aerial Application:** Use drift control spray equipment or thickening agents mixed with sprays to reduce drift. Apply through standard boom systems in a minimum spray volume of 5 gallons per surface acre. For Microfoil® drift control spray systems, apply DMA 4 IVM in a total spray volume of 12 to 15 gallons per acre. Apply to attain a concentration of 2 to 4 ppm (see table below).

†DMA 4 IVM contains 3.8 lb of acid equivalent per gallon of product.

Amount to Apply to Attain a Concentration of 2 to 4 ppm			
Surface Area	**Average Depth (ft)**	**2,4-D Acid Equivalent to Apply (lb/acre)**	**Amount of DMA 4 IVM to Apply (gal/acre)**
1 acre	1	5.4 to 10.8	1.42 to 2.84
	2	10.8 to 21.6	2.84 to 5.68
	3	16.2 to 32.4	4.26 to 8.53
	4	21.6 to 43.2	5.68 to 11.37
	5	27.0 to 54.0	7.10 to 14.21

The following table outlines rate calculations for Renovate 3 herbicide based on desired PPM and average depth of treatment area. It is taken directly from the Renovate 3 specimen label on SePRO Corporation's website: www.sepro.com

Concentration of Triclopyr Acid in Water (ppm ae)					
	Gallons of Renovate 3 per surface acre at specified depth				
Water Depth (feet)	0.75 ppm	1.0 ppm	1.5 ppm	2.0 ppm	2.5 ppm
1	0.7	0.9	1.4	1.8	2.3
2	1.4	1.8	3.3	3.6	4.6
3	2.1	2.9	4.1	5.4	6.8
4	2.7	3.6	5.4	7.2	9.1
5	3.4	4.5	6.8	9.0	11.3
6	4.1	5.4	8.1	10.9	13.6
7	4.8	6.3	9.5	12.7	15.8
8	5.5	7.2	10.9	14.5	18.1
9	6.1	8.1	12.2	16.3	20.4
10	6.8	9.0	13.6	18.1	22.6
15	10.2	13.6	20.4	27.2	33.9
20	13.6	18.1	27.2	36.2	45.3

16.2 Common Aquatic Plants of Indiana

(See 2006 Lake Management Plan)

16.3 Pesticide Use Restrictions Summary:

The following table was produced by Purdue University and included in the Professional Aquatic Applicators Training Manual. It gives a summary of water use restrictions on all major chemicals available for use in the aquatics market.

Table 19: Pesticide Use Restrictions

Table 1. Aquatic Herbicides and Their Use Restrictions. Always check the label because these restrictions are subject to change.

	Human			Animal	Irrigation		
	Drinking	Swimming	Fish Consumption	Drinking	Turf	Forage	Food Crops
	waiting period, in days						
Copper Chelate	0	0[a]	0	0	0	0	0
Copper Sulfate	0	0[a]	0	0	0	0	0
Diquat	1–3	0[a]	0	1	1–3	1–3	5
Endothall (granular)[b]	7	0[a]	3	0	7	7	7
Endothall (liquid)[b]	7–25	0[a]	3	7–25	7–25[d]	7–25	7–25
Endothall 191 (granular)[c]	7–25	0[a]	3	7–25	7–25	7–25	7–25
Endothall 191 (liquid)[c]	7–25	0[a]	3	7–25	7–25	7–25	7–25
Fluridone	0[e]	0[a]	0	0	7–30	7–30	7–30
Glyphosate	0[e]	0[a]	0	0	0	0	0
2,4-D (granular)	*	0[a]	0	*	*	*	*

[a]Although this compound has no waiting period for swimming, it is always advisable to wait 24 hours before permitting swimming in the direct area of treatment.

[b]Trade name is Aquathol®.

[c]Trade name is Hydrothol®.

[d]May be used for sprinkling bent grass immediately.

[e]Do not apply this product within 1/4 (fluridone) to 1/2 (glyphosate) mile upstream of potable water intakes.

*Do not use treated water for domestic purposes, livestock watering (2,4-D, dairy animals only), or irrigation.

16.4 Resources for Aquatic Management

In addition to the LARE Program, there are many other sources of potential funding to help improve the quality of Indiana Lakes. Many government agencies assist in projects designed to improve environmental quality.

The USDA has many programs to assist environmental improvement. More information on the following programs can be found at www.usda.gov.

Watershed Protection and Flood Prevention Program (USDA

Conservation Reserve Program (USDA)

Wetlands Reserve Program (USDA)

Grassland Reserve Program (USDA)

Wildlife Habitat Incentive Program (USDA)

Small Watershed Rehabilitation Program (USDA)

The following programs are offered by the U.S. Fish and Wildlife Service. More information about the Fish and Wildlife service can be found at www.fws.gov

Partners for Fish and Wildlife Program (U.S. Fish and Wildlife Service)

Bring Back the Natives Program (U.S. Fish and Wildlife Service)

Native Plant Conservation Program (U.S. Fish and Wildlife Service)

The Environmental Protection Agency, the Indiana Department of Environmental Management, and the U.S. Forest Service also have numerous programs for funding. A few of these are listed below. More information can be found at www.in.gov/idem and www.fs.fed.us/

U.S. Environmental Protection Agency Environmental Education Program (EPA)

NPDES Related State Program Grants (IDEM)

Community Forestry Grant Program (U.S. Forest Service)

16.5 State Regulations for Aquatic Plant Management

The following information is found on the IDNR website and outlines general regulations for the management of aquatic plants in public waters.

AQUATIC PLANT CONTROL PERMIT REGULATIONS
Indiana Department of Natural Resources

Note: In addition to a permit from IDNR, public water supplies cannot be treated without prior written approval from the IDEM Drinking Water Section. **Amended state statute adds biological and mechanical control (use of weed harvesters) to the permit requirements, reduces the area allowed for treatment without a permit to 625 sq ft, and updates the reference to IDEM.** *These changes become effective on July 1, 2002.*

Chapter 9. Regulation of Fishing
IC 14-22-9-10

Sec. 10. (a) This section does not apply to the following:

(1) A privately owned lake, farm pond, or public or private drainage ditch.

(2) A landowner or tenant adjacent to public waters or boundary waters of the state, who chemically, mechanically, or physically controls aquatic vegetation in the immediate vicinity of a boat landing or bathing beach on or adjacent to the real property of the landowner or tenant if the following conditions exist:

(A) The area where vegetation is to be controlled does not exceed:

(i) twenty-five (25) feet along the legally established, average, or normal shoreline;

(ii) a water depth of six (6) feet; and

(iii) a total surface area of six hundred twenty-five (625) square feet.

(B) Control of vegetation does not occur in a public waterway of the state.

(b) A person may not chemically, mechanically, physically, or biologically control aquatic vegetation in the public waters or boundary waters of the state without a permit issued by the department. All procedures to control aquatic vegetation under this section shall be conducted in accordance with rules adopted by the department under IC 4-22-2.

(c) Upon receipt of an application for a permit to control aquatic vegetation and the payment of a fee of five dollars ($5), the department may issue a permit to the applicant. However, if the aquatic vegetation proposed to be controlled is present in a public water supply, the department may not, without prior written approval from the department of environmental management, approve a permit for control of the aquatic vegetation.

(d) This section does not do any of the following:

(1) Act as a bar to a suit or cause of action by a person or governmental agency.

(2) Relieve the permittee from liability, rules, restrictions, or permits that may be required of the permittee by any other governmental agency.

(3) Affect water pollution control laws (as defined in IC 13-11-2-261) and the rules adopted under water pollution control laws (as defined in IC 13-11-2-261).

As added by P.L.1-1995, SEC.15. Amended by P.L.1-1996, SEC.64.

312 IAC 9-10-3 Aquatic vegetation control permits

Authority: IC 14-22-2-6; IC 14-22-9-10
Affected: IC 14-22-9-10

Sec. 3. (a) Except as provided under IC 14-22-9-10(a), a person shall obtain a permit under this section before applying a substance to waters of this state to seek aquatic vegetation control.

(b) An application for an aquatic vegetation control permit shall be made on a departmental form and must include the following information:

(1) The common name of the plants to be controlled.

(2) The acreage to be treated.

(3) The maximum depth of the water where plants are to be treated.

(4) The name and amount of the chemical to be used.

(c) A permit issued under this section is limited to the terms of the application and to conditions imposed on the permit by the department.

(d) Five (5) days before the application of a substance permitted under this section, the permit holder must post clearly, visible signs at the treatment area indicating the substance that will be applied and

what precautions should be taken.
(e) A permit issued under this section is void if the waters to be treated are supplied to the public by a private company or governmental agency. *(Natural Resources Commission; 312*

16.6 Public Questionnaire

Lake Use Survey (18 total) Lake name Big Lake

Are you a lake property owner? Yes 17 No 1

Are you currently a member of your lake association? Yes 17 No 0

How many years have you been at the lake?
2 or less - 0
2 – 5 years - 3
5-10 years - 5
Over 10 years - 10

How do you use the lake (mark all that apply)

17 Swimming	4 Irrigation
18 Boating	0 Drinking water
17 Fishing	2 Other Skiing

Do you have aquatic plants at your shoreline in nuisance quantities? Yes 14 No 4

Do you currently participate in a weed control project on the lake? Yes 15 No 3

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes 16 No 2

Does the level of vegetation in the lake affect your property values? Yes 12 No 6

Are you in favor of continuing efforts to control vegetation on the lake? Yes 17 No 0

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes 18 No 0

Mark any of these you think are problems on your lake:

2	Too many boats access the lake
3	Use of jet skis on the lake
0	Too much fishing
3	Fish population problem
7	Dredging needed
1	Overuse by nonresidents
12	Too many aquatic plants
0	Not enough aquatic plants
10	Poor water quality
1	Pier/funneling problem

Please add any comments:
Do we have too many turtles?; Are there negatives to throwing fish remains back in the lake after cleaning; I don't live right on water; need to address run off from surrounding farms.

16.7 Species Distribution Maps

Figure 9: 2007 Rake Sample Locations

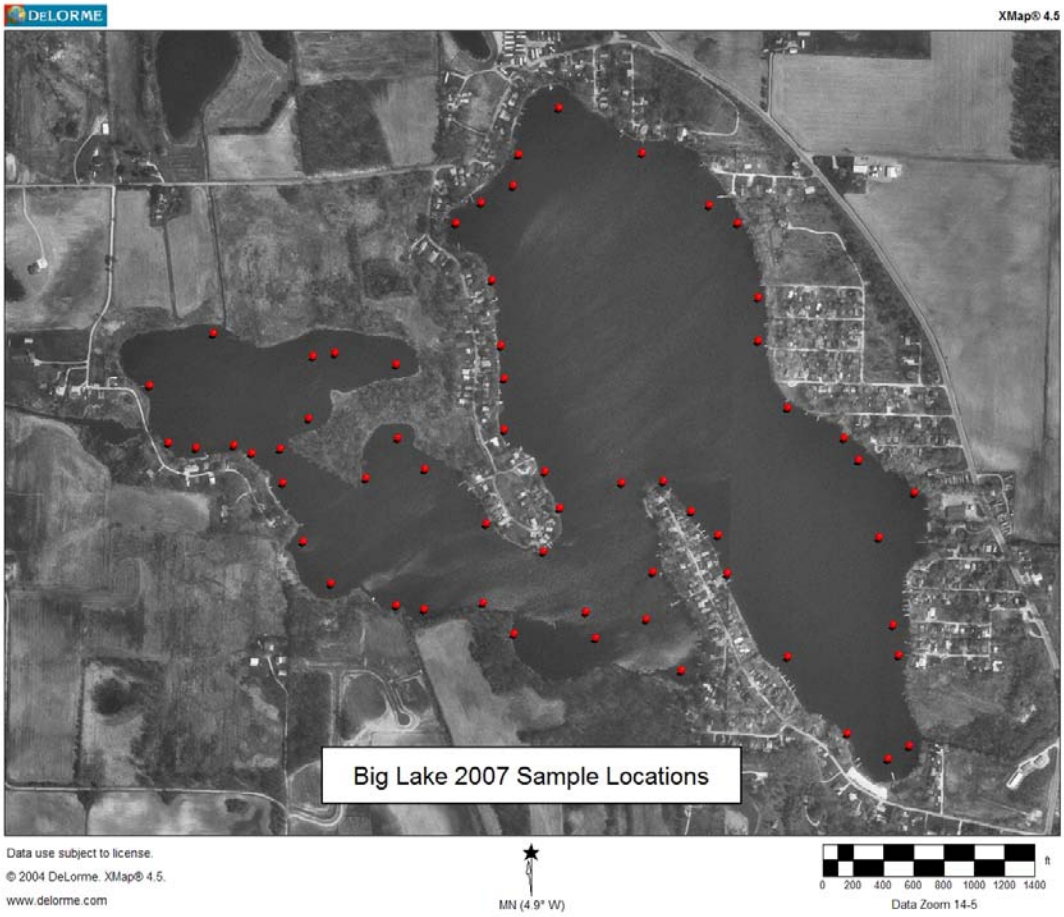

Figure 10: May 2007 Slender Naiad Locations

Figure 11: May 2007 Large Leaf Pondweed Locations

Figure 12: May 2007 Flat-Stemmed Pondweed Locations

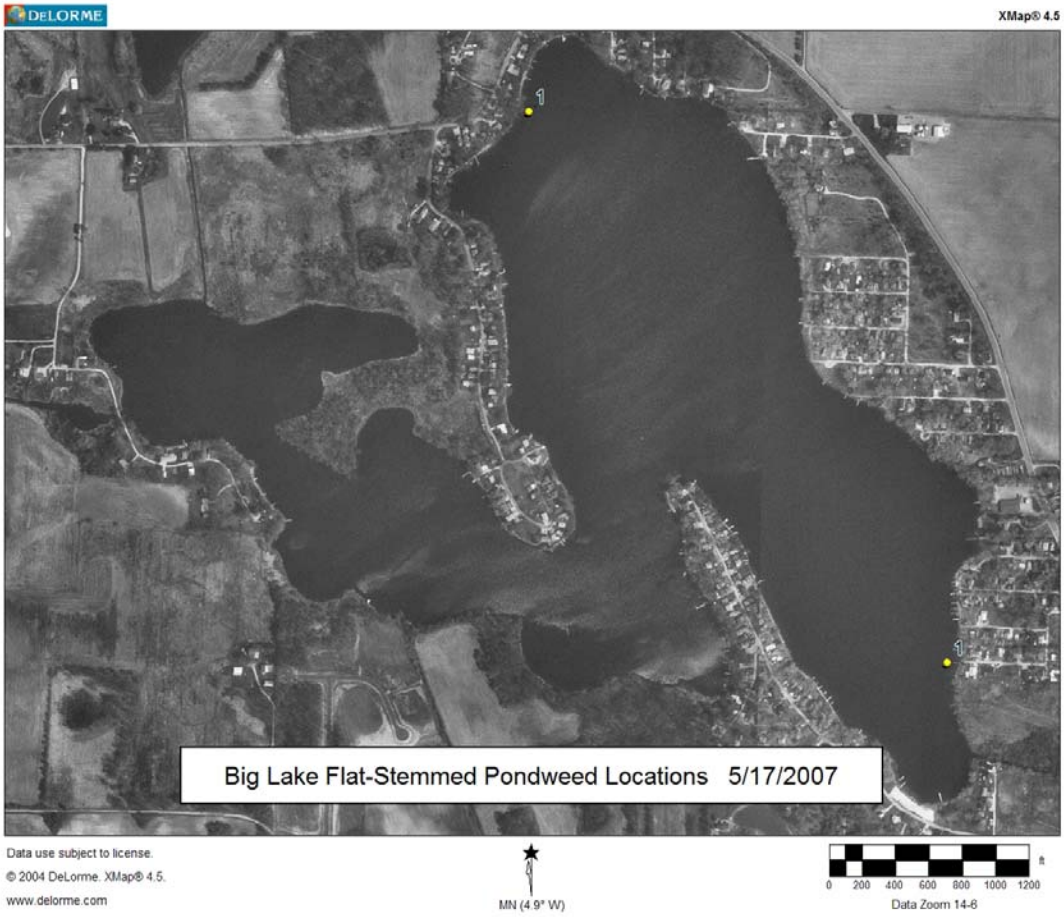

Figure 13: May 2007 Eurasian Watermilfoil Locations

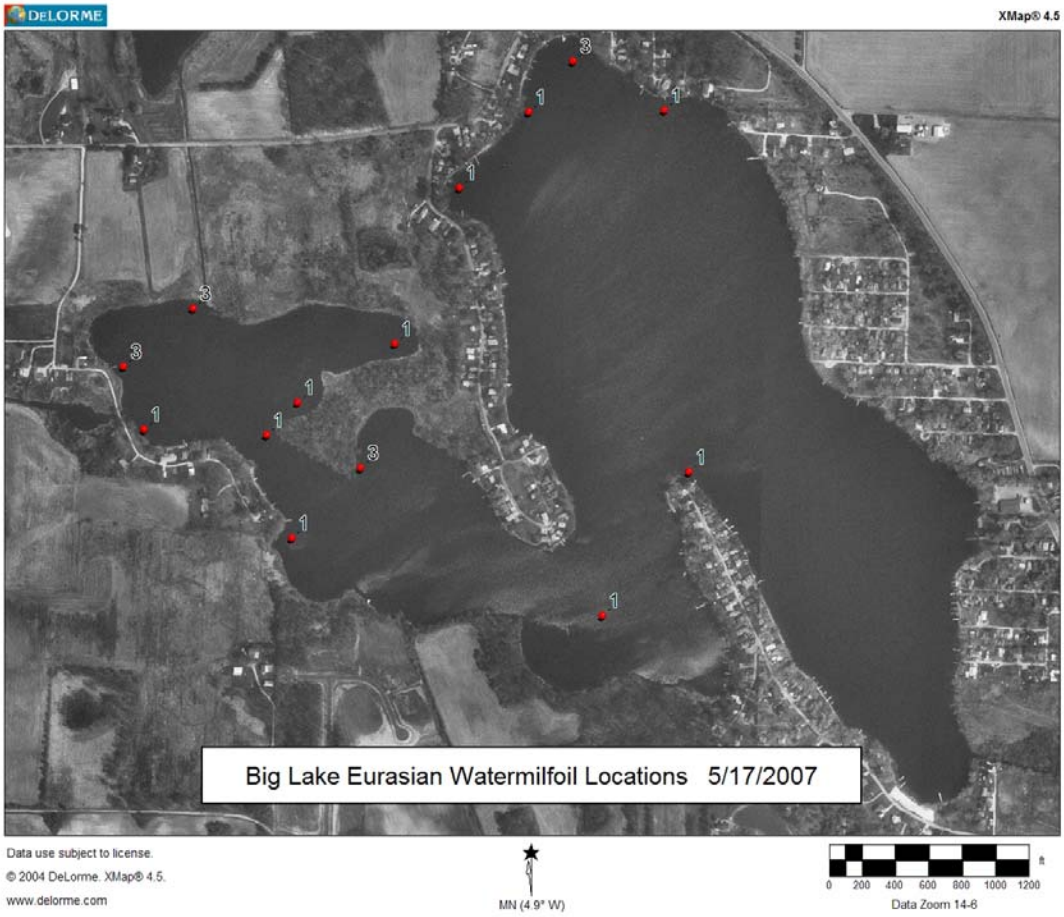

Figure 14: May 2007 Elodea Locations

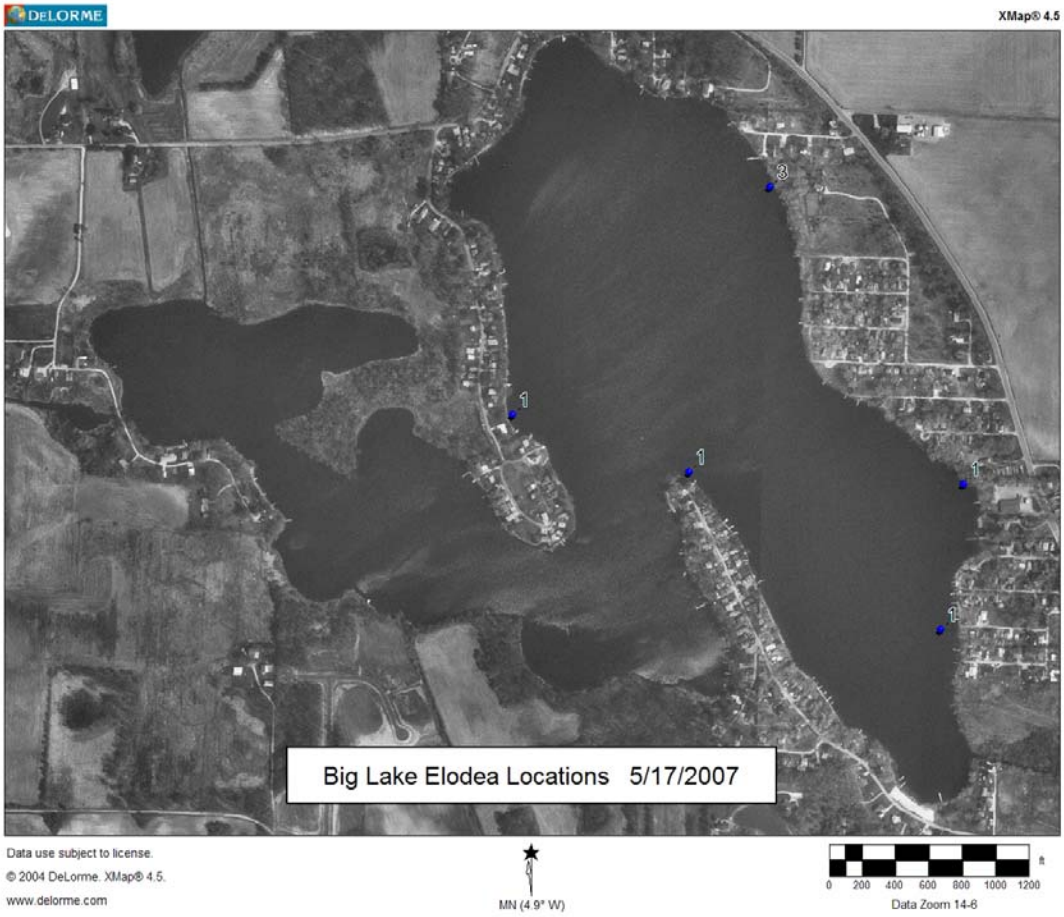

Figure 15: May 2007 Curly Leaf Pondweed Locations

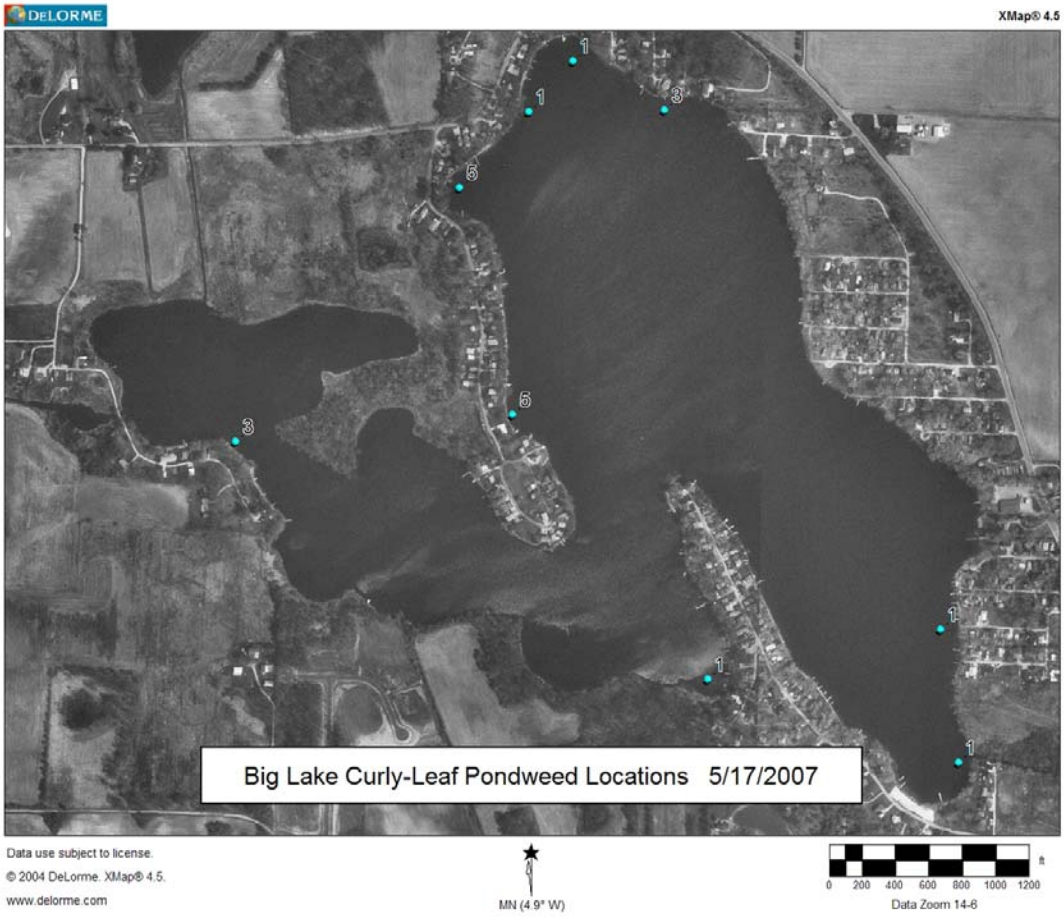

Figure 16: May 2007 Coontail Locations

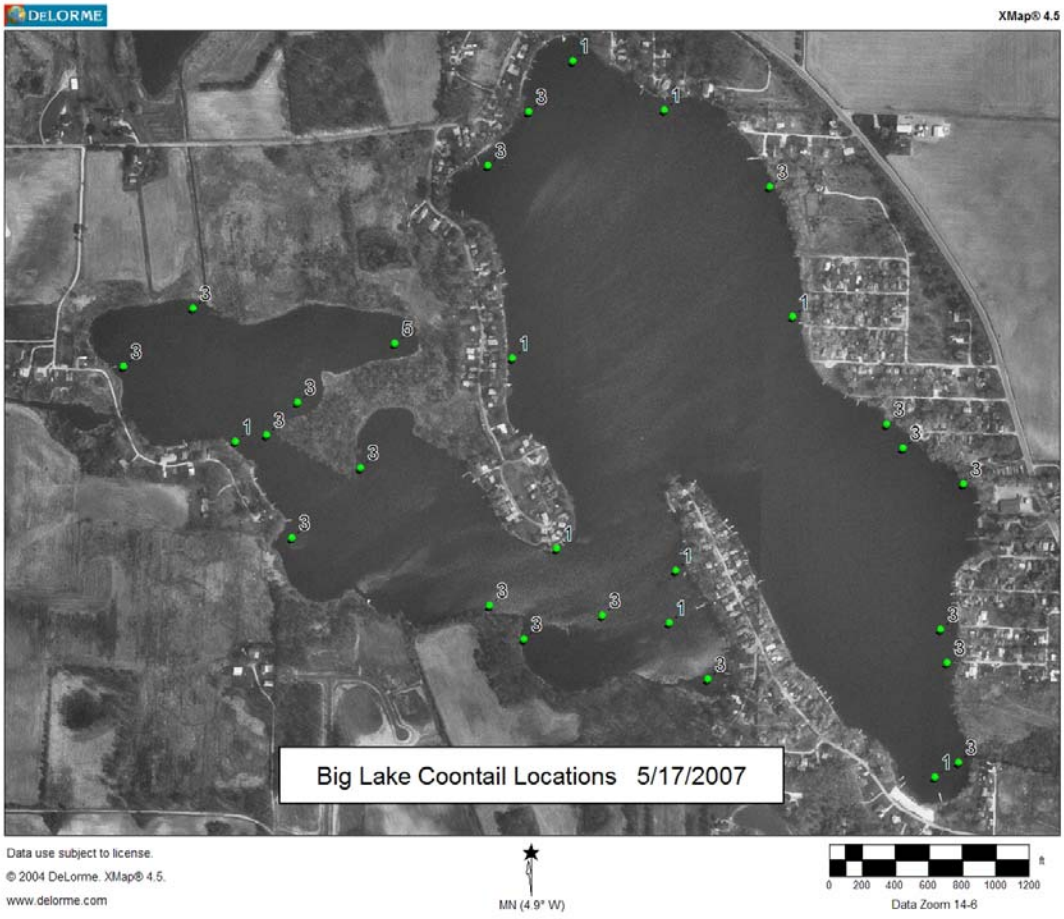

Figure 17: May 2007 Chara Locations

August 2007

Figure 18: August 2007 Sago Pondweed Locations

Figure 19: August 2007 Slender Naiad Locations

Figure 20: August 2007 Leafy Pondweed Locations

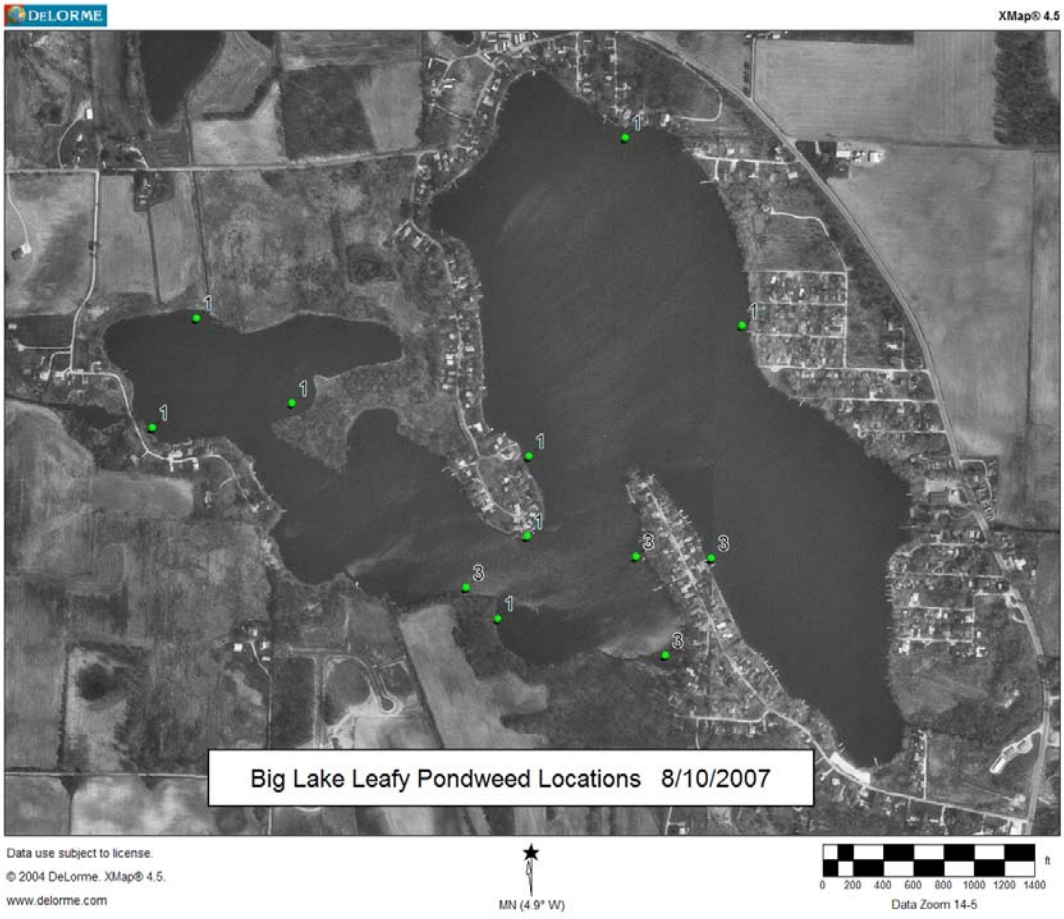

Figure 21: August 2007 Large Leaf Pondweed Locations

Figure 22: August 2007 Illinois Pondweed Locations

Figure 23: August 2007 Flat-Stemmed Pondweed Locations

Figure 24: August 2007 Eurasian Watermilfoil Locations

Figure 25: August 2007 Eel Grass Locations

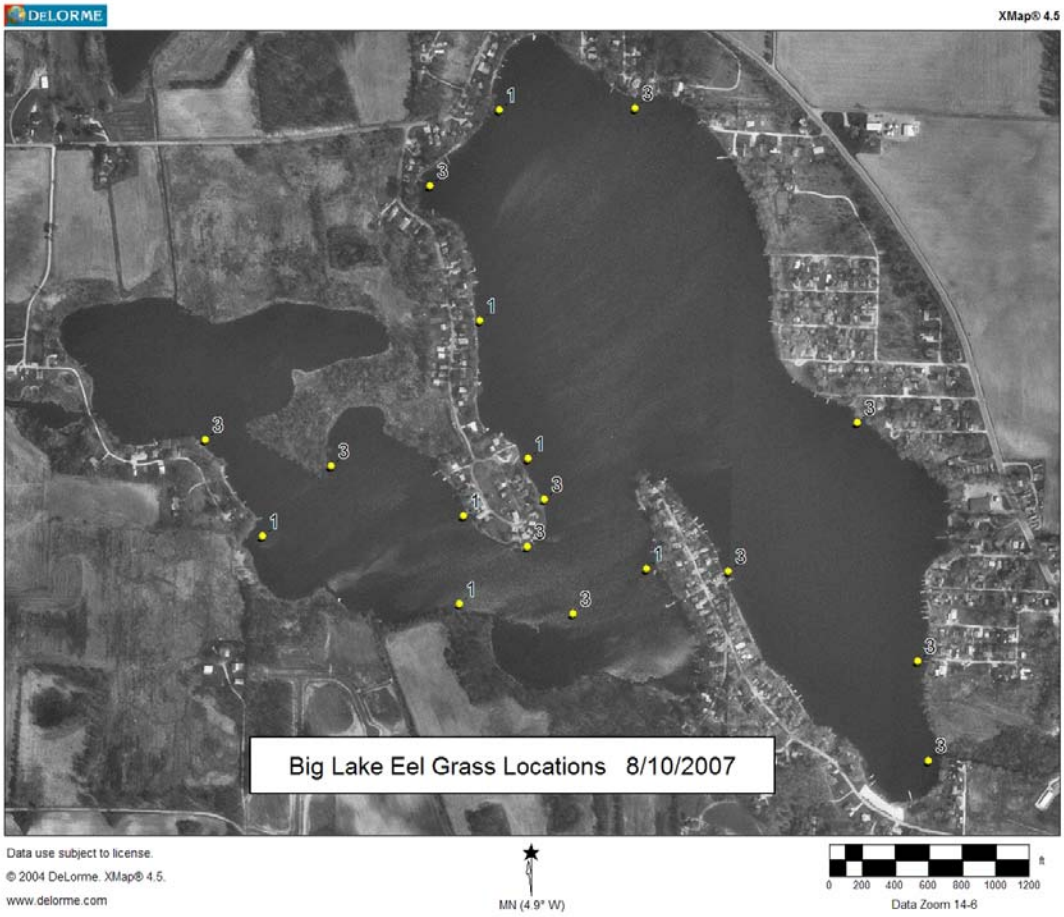

Figure 26: August 2007 Curly Leaf Pondweed Locations

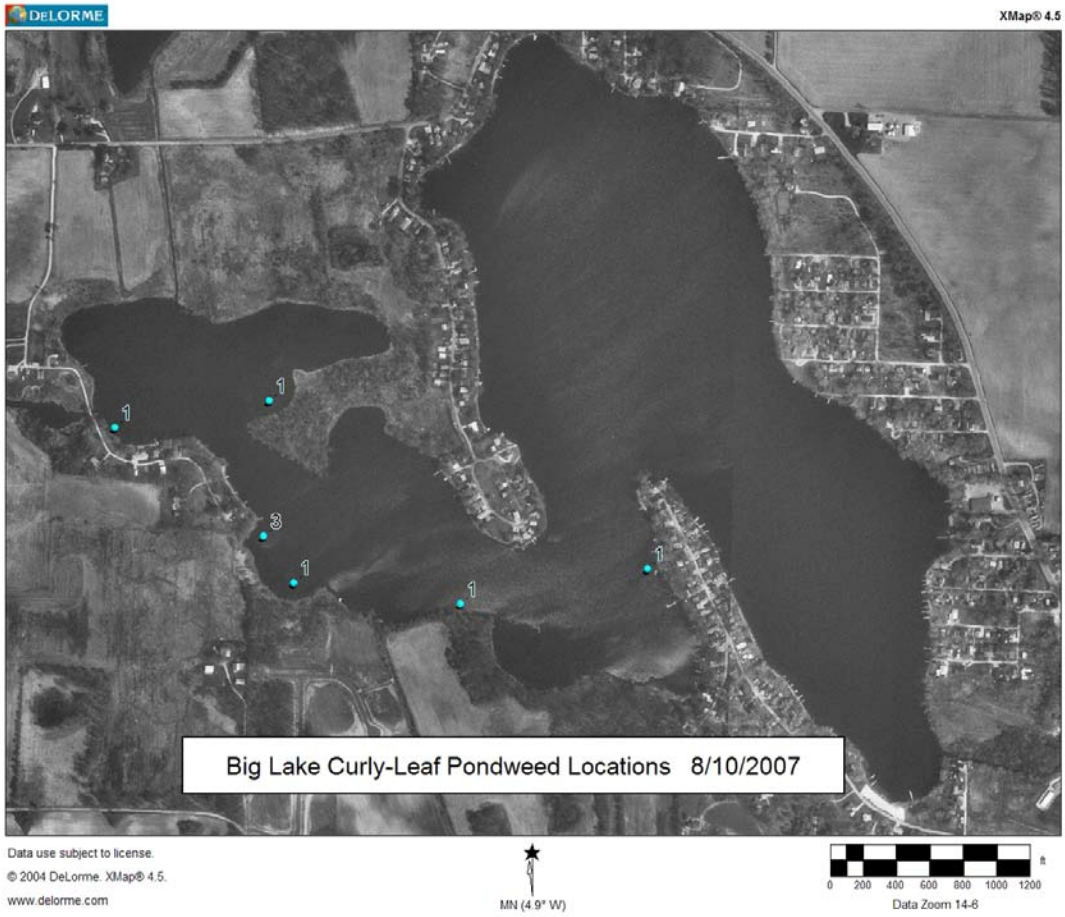

Figure 27: August 2007 Coontail Locations

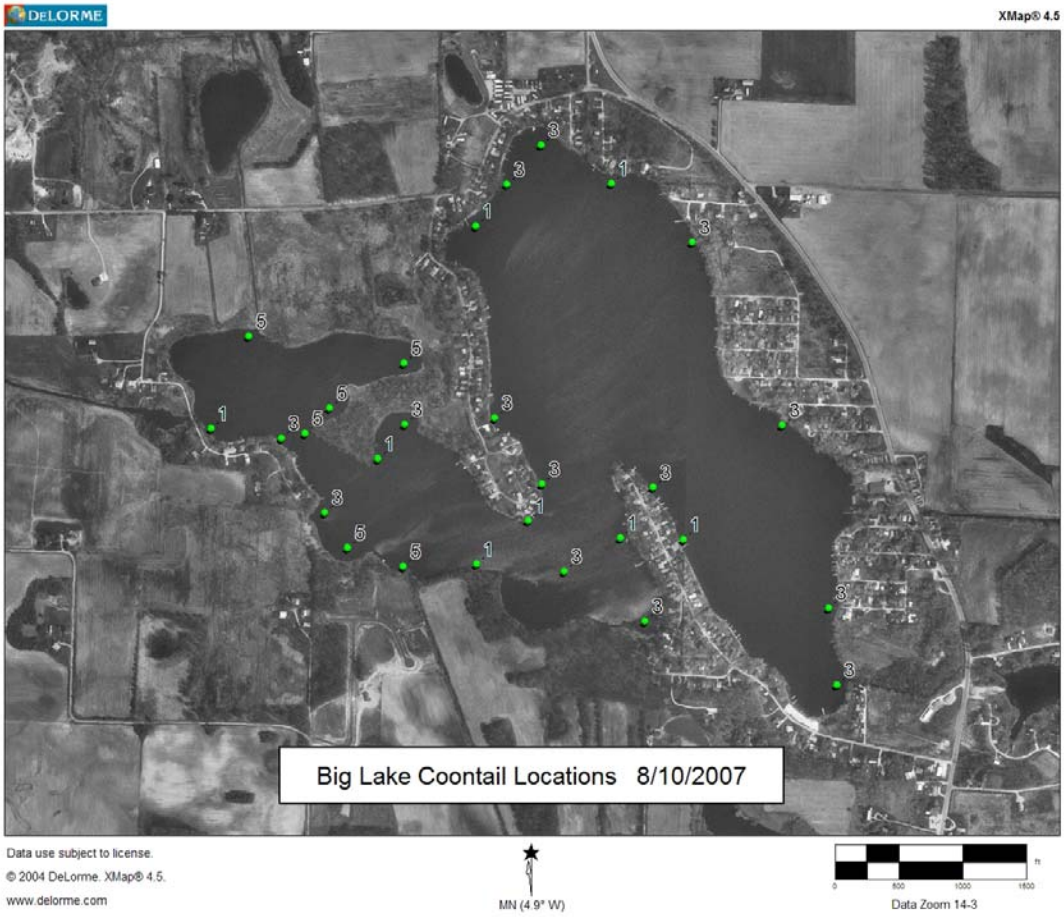

Figure 28: August 2007 Chara Locations

16.8 Data Sheets

10

Aquatic Vegetation Random Sampling

Waterbody Cover Sheet

Organization Name: Big Lake Association

Waterbody Name: Big Lake Lake ID:

County: Noble Date: May 17, 2007

Habitat Stratum: IL Ave. Lake Depth (ft): 25 ft Lake Level: Avg

GPS Metadata

Crew Leader: Dave Keister NAD83 (Datum:) 16 (Zone:) 30 ft (Accuracy:)

Recorder: Dave Keister Method: WAAS Enabled GPS

Secchi Depth (ft): 5 ft Total # of Sites Surveyed: 60 Total # of Species: 8

Littoral Zone Size (acres): 40 ac

- ☐ Measured
- ☒ Estimated

Littoral Zone Max. Depth (ft): 15 ft

- ☐ Measured
- ☐ Estimate (historical Secchi)
- ☒ Estimated (current Secchi)

Notable Conditions: Curly leaf very prevalent in North end of Basin #1 E. milfoil also prevalent in north end of Basin #1 as well as Basin # 3

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 1 of 2

WATERBODY NAME: Big Lake	DATE: May 17, 2007
COUNTY: Noble	SECCHI DEPTH (FT): 5 ft
SITE ID: Big	MAX PLANT DEPTH (FT): ~9ft
SURVEYING ORGANIZATION: Aquatic Weed Control	WEATHER: Overcast, Breezy, Temp 58°
CREW LEADER: Dave Reister	COMMENTS (Include voucher codes - V1, V2...): Water Temp 65°-66° F
RECORDER: Dave Reister	
CONTACT INFO: 574-533-2597	Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.

Point #	All Random R/T	Latitude	Longitude	Depth	Species Codes: CERDEM	MYRSPI	POTAMP	POTZOS	NAJFLE	FIDCAN	CHARA	POCRI	Algae Notes
1	R			2	3							1	P
2	↓	GPS WayPoints		2	3		1	1					P
3				2	3					1			P
4				2	3								
5	↓	↓	↓	2.5	1								P
6				2.5	3					3			P
7				2.5	1	1						3	P
8				2.5	3	1		1				1	P
9				3		1						5	P
10				3					1				P
11				3						1		5	P
12				3							1		P
13				3									P
14				3	3	3					1		
15				3.5	3	1							
16				3.5	5	1							
17				3.5	3	3							P
18				3.5		1							P
19				3.5	1							3	
20				3.5	3	1							P
21				4									
22				4	3								
23				4	3								P
24				4	3	1							
25				4.5	3							1	P
26				4.5	1								P
27				5		1				1			P
28				5									P
29				5									P
30				5	1								
31				6	3					1		1	P
32				6	3								

Other plant species observed at lake:

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 2 of 2

WATERBODY NAME: Big Lake	DATE: May 17, 2007
COUNTY: Noble	SECCHI DEPTH (FT): 5ft
SITE ID: Big	MAX PLANT DEPTH (FT): ~9ft
SURVEYING ORGANIZATION: Aquatic Weed Control	WEATHER: overcast Breezy Temp 55
CREW LEADER: Dave Keister	COMMENTS (Include voucher codes - V1, V2...):
RECORDER: Dave Keister	Water Temp 65-66° F
CONTACT INFO: 574-533-2597	*Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.*

Point #	All Points R/T	Latitude	Longitude	Depth	Species Codes: CERDEM	MYRSPI	POTAMI	POTCRI					Algae Notes
32	R												
33	↓	GPS Waypoints											
34													
35			↓		1	3	3	3					P
36					3								
37		↓											
38					1								
39													
40					1								
41													
42					3	1							
43													
44					3	3							
45													
46													
47													
48					1								
49													
50													
51													
52													
53													
54													
55													
56													
57													
58													
59													
60													

Other plant species observed at lake:

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet

Surveying Organization: Aquatic Weed Control

Contact Information: 574-533-2597

Waterbody Name: Big Lake

Lake ID: Big

County(s): Noble

Date: August 10, 2021

Habitat Stratum: IL

Avg. Lake Depth (ft): 25 ft

Lake Level: Avg

GPS Metadata

Crew Leader: Dave Keister

Datum: NAD83

Zone: 16

Accuracy: 30 ft

Recorder: Dave Keister

Method: WAAS Enabled GPS

Secchi Depth (ft): 4.1 ft

Total # of Points Surveyed: 60

Total # of Species: 11

Littoral Zone Size (acres): 40 acres

- ☐ Measured
- ☒ Estimated

Littoral Zone Max. Depth (ft): 15 ft

- ☐ Measured
- ☐ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions: E milfoil observed only in bottleneck between basins 2 and 3 (damaged).

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 1 of 3

WATERBODY NAME: Big Lake	DATE: August 10, 2007
COUNTY: Noble County	SECCHI DEPTH (FT): 4.1 ft
SITE ID: Big	MAX PLANT DEPTH (FT): 9.5 ft
SURVEYING ORGANIZATION: Aquatic Weed Control	WEATHER: Partly Cloudy Temp mid 80's
CREW LEADER: Dave Keister	COMMENTS (Include voucher codes - V1, V2...):
RECORDER: Dave Keister	
CONTACT INFO: 574-527-2597	*Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.*

Point #	R/T	Latitude	Longitude	Depth	Species Codes: (ceratophyllum)	UALAME	NAJFLE	Chara	POTFOL	STUPEC	POTZOS	POTCRI	A-16 Notes
->	R	GPS Points	1	2	3	2							P
			2	2	3	3	3	3					
			3	2	–								
			4	2	3	3	1						
			5	2.5			1		1				P
			6	2.5	3			3		1			P
			7	2.5	1	3	1		1				P
			8	2.5	3	1	1						P
			9	3		3							P
			10	3		1							P
			11	3	3								
			12	3	3	3	1						
			13	3		1							
			14	3	1	3	1				1		P
			15	3	5				1			1	P
			16	3.5	5								
			17	3.5	5				1				
			18	3.5	1				1	1		1	P
			19	3.5	3	3	1						LARGE-1
			20	3.5	3	1	1					3	milfoil-1
			21	4	5								
			22	4	1	1		1	3		1	1	
			23	4					1				P
			24	4	3	3	1	3					F11-1
			25	4.5	3		3		3				P
			26	4.5	1	1		3	3			1	
			27	5									
			28	5	1	3	3		3				
			29	5									
			30	5	–								
			31	6	–								
			32	6	–								
			33	6	–								

Other plant species observed at lake:

Aquatic Weed Control

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 2 of 3

WATERBODY NAME: Big Lake	DATE: August 10, 2007
COUNTY: Noble	SECCHI DEPTH (FT): 4.1 ft
SITE ID: Big	MAX PLANT DEPTH (FT): 9.5 ft
SURVEYING ORGANIZATION: Aquatic Weed Control	WEATHER: Partly Cloudy temp mid 80's
CREW LEADER: Dave Keister	COMMENTS (Include voucher codes - V1, V2...):
RECORDER: Dave Keister	
CONTACT INFO: 574-533-2597	*Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.*

Point #	R/T	Latitude	Longitude	Depth	Species Codes: Ceradem	Valame	Naj	ELO	Chara	POTFOL	POTCRI			A/G Notes
→	R	GPS Points	34	6.5	—									
			35	6.5	3									P
			36	6.5	1									
			37	7	—									
			38	7			1							
			39	7		1				1				P
			40	7.5	1	3				1				
			41	7.5	3									
			42	7.5	5									
			43	8	—									
			44	8.5	—									
			45	8.5	—									
			46	8.5	5						1			
			47	9	—									
			48	9	—									
			49	9.5	3	1								
			50	10	—									
			51	10.5	—									
			52	12	—									
			53	12	—									
			54	12.5	—									
			55	12.5	—									
			56	12.5	—									
			57	13	—									
			58	13	—									
			59	14	—									
			60	15	—									

Other plant species observed at lake:

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 3 of 3

WATERBODY NAME: Big Lake	DATE: August 10, 2007
COUNTY: Noble County	SECCHI DEPTH (FT): 4.1
SITE ID: Big	MAX PLANT DEPTH (FT): 9.5
SURVEYING ORGANIZATION: Aquatic Weed Control	WEATHER: Partly Cloudy Temp mid 80's
CREW LEADER: Dave Reister	COMMENTS (Include voucher codes - V1, V2...):
RECORDER: Dave Reister	
CONTACT INFO: 574-533-2597	*Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.*

Point #	Depth R/T	Oxygen Latitude	Temp Longitude	Depth	Species Codes:								Notes
	0	8.98	85.7										
	1.5	9.02	85.5										
	3	9.01	85.4										
	4.5	9.02	85.3										
	6	9.09	85.1										
	7.5	8.98	84.4										
	9	9.70	80.8										
	10.5	9.54	79.7										
	12	1.33	76.0										
	13.5	0.68	71.7										
	15	0.12	66.9										
	16.5	0.08	64.0										
	18	0.06	59.0										
	19.5	0.05	56.5										
	21	0.03	52.8										
	22.5	0.03	51.1										
	24	0.03	48.6										
	25.5	0.02	48.4										
	27	0.02	47.7										
	28.5	0.02	47.3										
	30	0.02	47.2										

Other plant species observed at lake:

Sample Location GPS Coordinates

1	R	41.27021	-85.49364
2	R	41.27185	-85.49388
3	R	41.27479	-85.49352
4	R	41.27577	-85.49520
5	R	41.27754	-85.49727
6	R	41.27967	-85.49776
7	R	41.28094	-85.50007
8	R	41.28091	-85.50303
9	R	41.27966	-85.50455
10	R	41.27744	-85.50346
11	R	41.27593	-85.50339
12	R	41.27450	-85.50204
13	R	41.27423	-85.50382
14	R	41.27505	-85.50671
15	R	41.27613	-85.50809
16	R	41.27710	-85.50597
17	R	41.27767	-85.51039
18	R	41.27569	-85.51146
19	R	41.27549	-85.50946
20	R	41.27390	-85.50822
21	R	41.27275	-85.50598
22	R	41.27279	-85.50390
23	R	41.27223	-85.50314
24	R	41.27263	-85.50142
25	R	41.27157	-85.49912
26	R	41.27336	-85.49981
27	R	41.27499	-85.49954
28	R	41.27332	-85.49802
29	R	41.27043	-85.49513
30	R	41.26997	-85.49415
31	R	41.27240	-85.49403
32	R	41.27538	-85.49485
33	R	41.27632	-85.49657
34	R	41.27832	-85.49727
35	R	41.28175	-85.50207
36	R	41.28003	-85.50393
37	R	41.27863	-85.50368
38	R	41.27686	-85.50339
39	R	41.27517	-85.50240
40	R	41.27372	-85.50243
41	R	41.27578	-85.50594
42	R	41.27559	-85.50877

43	R	41.27732	-85.50745
44	R	41.27672	-85.51191
45	R	41.27565	-85.50989
46	R	41.27314	-85.50756
47	R	41.27267	-85.50532
48	R	41.27250	-85.49997
49	R	41.27444	-85.49888
50	R	41.27182	-85.49657
51	R	41.27398	-85.49435
52	R	41.27999	-85.49844
53	R	41.28035	-85.50317
54	R	41.27521	-85.50530
55	R	41.27726	-85.50799
56	R	41.27560	-85.51080
57	R	41.27497	-85.50872
58	R	41.27216	-85.50119
59	R	41.27496	-85.50055
60	R	41.27402	-85.49824

16.9 IDNR Aquatic Vegetation Control Permit

To be included in the final report.